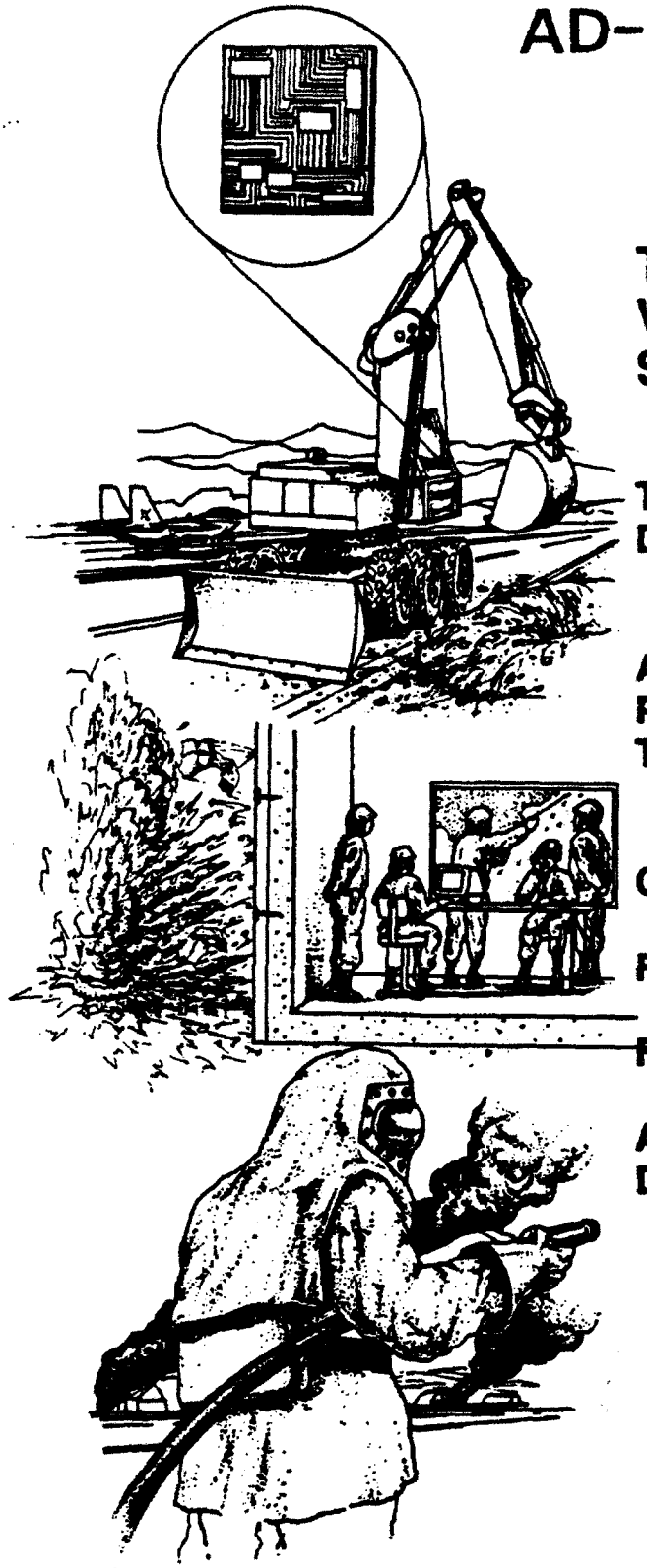

ESL-TR-91-22
Volume II

THE POST-DAM SYSTEM VOLUME II - POST-DAM EXPERT SYSTEM (PDES)

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13. ABSTRACT *(Maximum 200 words)*

Mission accomplishment in PACAF and USAFE depends on base recovery capability in a postattack environment. Base recovery includes identifying, analyzing, and repairing facility damage. For facilities critical to sortie generation, this process must be accomplished expediently.

In a postattack environment, field information on facility damage is collected and analyzed to determine structural integrity and usability. From this analysis, a repair schedule is developed. This is currently a time comsuming process that is shortened by using a computerized system.

The scope of this effort was to develop a computerized postattack damage assessment system that recommends repair strategies, keeps inventory of materials and equipment, and schedules repairs based on manpower and equipment availability.

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EXECUTIVE SUMMARY

A. OBJECTIVE

The objective of this report is to describe the software and hardware of the POST-DAM System, developed by Applied Research Associates, Inc., for airbase facility postattack damage assessment. This report contains descriptions of prototype software and hardware, and recommendations for full-scale development of both software and hardware.

B. BACKGROUND

In a postattack environment, field information on mission-critical facility damage is collected and analyzed to determine structural integrity and usability. From this analysis, a repair schedule is developed. This is a time-consuming process when done without the aid of a computerized system. Consequently, the POST-DAM System was developed to determine repair strategies with an expert system, keep track of materials and equipment with a relational database management system, and schedule repairs based on manpower and equipment availability with a project management system.

C. SCOPE

This technical report consists of nine volumes. Volume I describes software and hardware used with the prototype POST-DAM System, and recommends software and hardware for full-scale development. Volumes II through VIII are software user's manuals, which describe how to install and use the prototype software with the POST-DAM System. Volume IX is a field manual that contains diagrams of structures that are used with the POST-DAM system to locate damaged elements.

D. EVALUATION METHODOLOGY

The prototype POST-DAM System was developed using commercial, off-the-shelf (COTS) software and hardware. The system was constructed by integrating the software and hardware in such a way that a remote computer in the field can communicate with a host computer in the Base Civil Engineering (BCE) Damage Control Center (DCC). The POST-DAM system determines repair strategies, keeps track of materials and equipment, and schedules repairs based on manpower and equipment availability. This prototype system has been evaluated in-depth, and subsequent recommendations are made herein about software and hardware that should be used for full-scale development.

E. CONCLUSIONS

The prototype POST-DAM System is functional, but has limitations with respect to both hardware and software. The following problems were encountered:

1. The prototype remote computer is not portable, and cannot be used in the field. No satisfactory, hand-held remote terminal was available for this project.

2. The expert system cannot hold all the information required for full-scale development, because it cannot use extended memory.

3. Both the relational database management system and project management system require more human interaction than desired.

4. The communication system software is not compatible with the Survivable Base Recovery After Attack Communication System (SBCS) being developed for ESD by Sumaria Systems, Inc., with which the POST-DAM System is required to interface.

F. RECOMMENDATIONS

For full-scale development, the following features should be incorporated in the POST-DAM System.

1. Replace the prototype remote computer with a hand-held terminal unit having at least 2 Mb of random access memory, and which can run applications requiring 640 Kb of base memory.

2. Replace the prototype host computer with a system having at least 4 Mb of random access memory, IEEE 802.3 LAN ports, and able to support multi-tasking operations.

3. Replace the CLIPS expert system shell with an expert system shell capable of supporting applications at least twice as large as those developed for the prototype system.

4. Set the host computer up to interface with the IEEE 802.3 Ethernet local area network (LAN) used by SBCS.

5. Construct a single computer program to replace the relational database management system and the project management system, to minimize the required amount of human intervention. This system should be developed by personnel with a strong background in computer science.

PREFACE

This report was prepared by Applied Research Associates, Inc. (ARA), P.O. Box 40128, Tyndall Air Force Base, FL 32403, under Contract F08635-88-C-0067, for the Air Force Civil Engineering Support Agency, Tyndall Air Force Base, Florida.

This report (Volumes I though IX) summarizes work completed between 1 February 1989 and 1 March 1991. Lt. James Underwood (USN) was the HQ AFCESA/RACS Project Officer.

This report has been reviewed by the Public Affairs Office, and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Dan Shenbach, Maj., IAF
Project Officer

Felix Uhlik, Lt. Col., USAF
Chief, Engineering Research Division

William S. Strickland
Chief, Airbase Survivability Branch

Frank P. Gallagher, III, Col., USAF
Director, Civil Engineering Laboratory

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SECTION 1

INTRODUCTION

1.1 OBJECTIVE

The objective of this software user's manual (SUM) is to document system and user requirements for proper operation of the POST-DAM Expert System (PDES) developed in compliance with References 2.1.1, 2.1.2, and 2.1.3. System requirements are discussed in Section 3.1 of the manual, and involve both hardware and software requirements. User requirements are discussed in Sections 3.2 and 3.3, and document the procedures for installing and operating PDES.

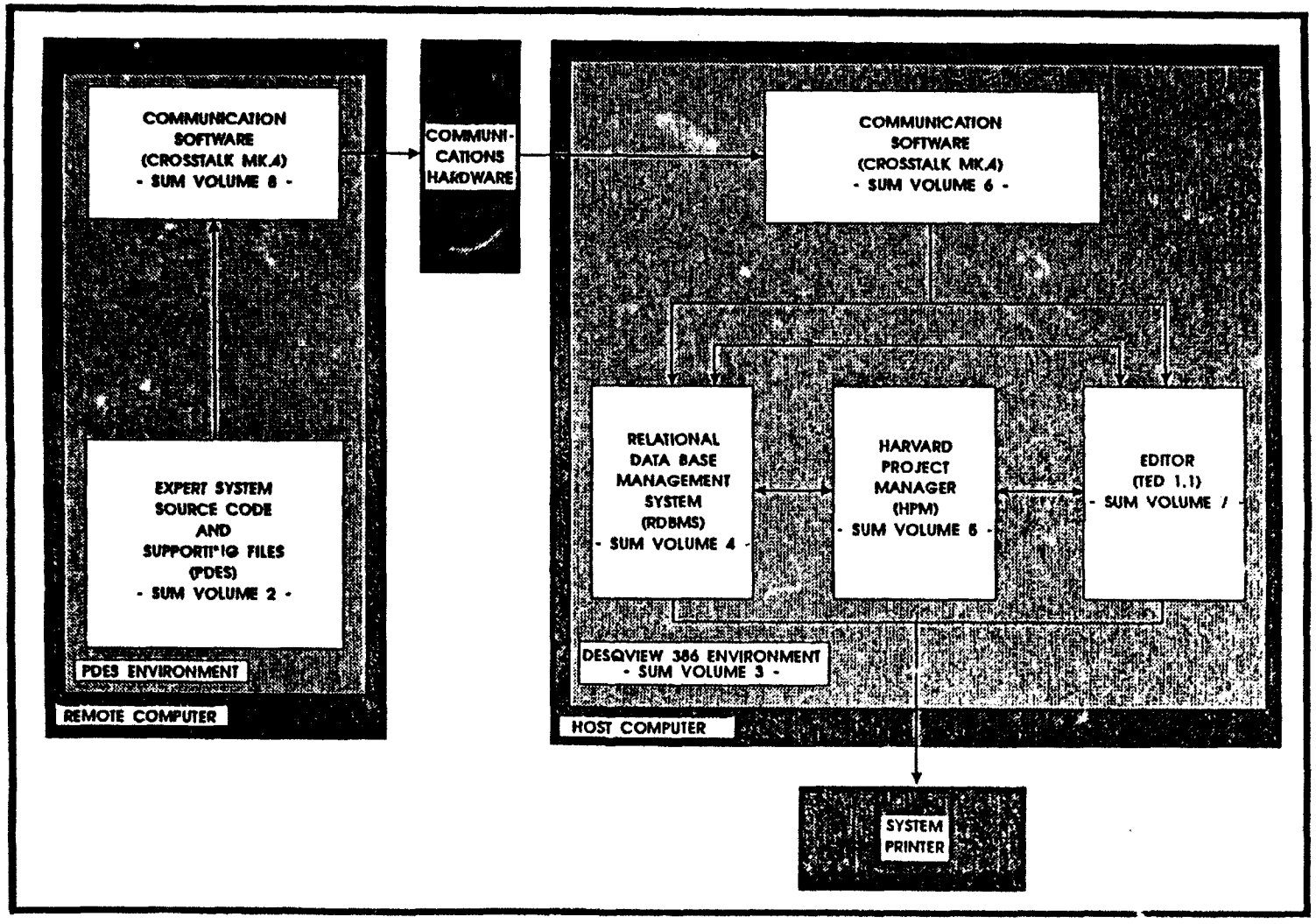
1.2 BACKGROUND

PDES was constructed using the C-based expert system language CLIPS (C Language Integrated Production System) developed jointly by NASA and the USAF (Reference 2.3.1). PDES was delivered to RDCS in source code form, along with its CLIPS interpreter to permit compiling the program at execution time. Creating a DOS runtime version of PDES was not practical, since runtime versions do not allow the use of many CLIPS environmental commands and embedded functions. The expedient repair strategies and required resource equations utilized by PDES were developed separately (References 2.1.4 and 2.1.5).

1.3 APPROACH

PDES is one component of the computer-based facility postattack damage assessment system, POST-DAM. This relationship is shown schematically in Figure 1.1. PDES is a knowledge-based system which utilizes an inference engine to determine expedient repair strategies for conventional weapon damage to mission-critical airbase facilities. The system operates by asking the user questions about a damaged facility. From the answers, the expert system selects the most appropriate expedient repair strategy from its knowledge base, compiled beforehand by base engineer personnel. This information is then communicated to the POST-DAM System's host computer for further evaluation.

In operation, PDES is a highly interactive, multilevel, menu-driven expert system. It enables the user, in a postattack situation, to assess structural damage of any predetermined mission-critical facility on a particular airbase. Once a mission-critical facility has been selected, PDES can further distinguish between mission-critical and non-mission-critical structural elements. These two PDES capabilities are possible because the system's inference engine uses both static and dynamic knowledge bases. The static knowledge base is used in the phase-control firing of PDES rules and in setting system defaults. The data field in this knowledge base is used to initialize PDES. The dynamic knowledge base contains element-specific data on various mission-critical facilities. This knowledge base allows PDES to be tailored to any number of airbases and mission-critical facilities, by inserting airbase-specific data files into the expert system's knowledge base. Figure 1.2 shows how PDES uses the concept of a static and a dynamic knowledge base, along with its Rules Base to arrive at its expert advice.



POST-DAM SYSTEM

Figure 1.1. POST-DAM System Schematic.

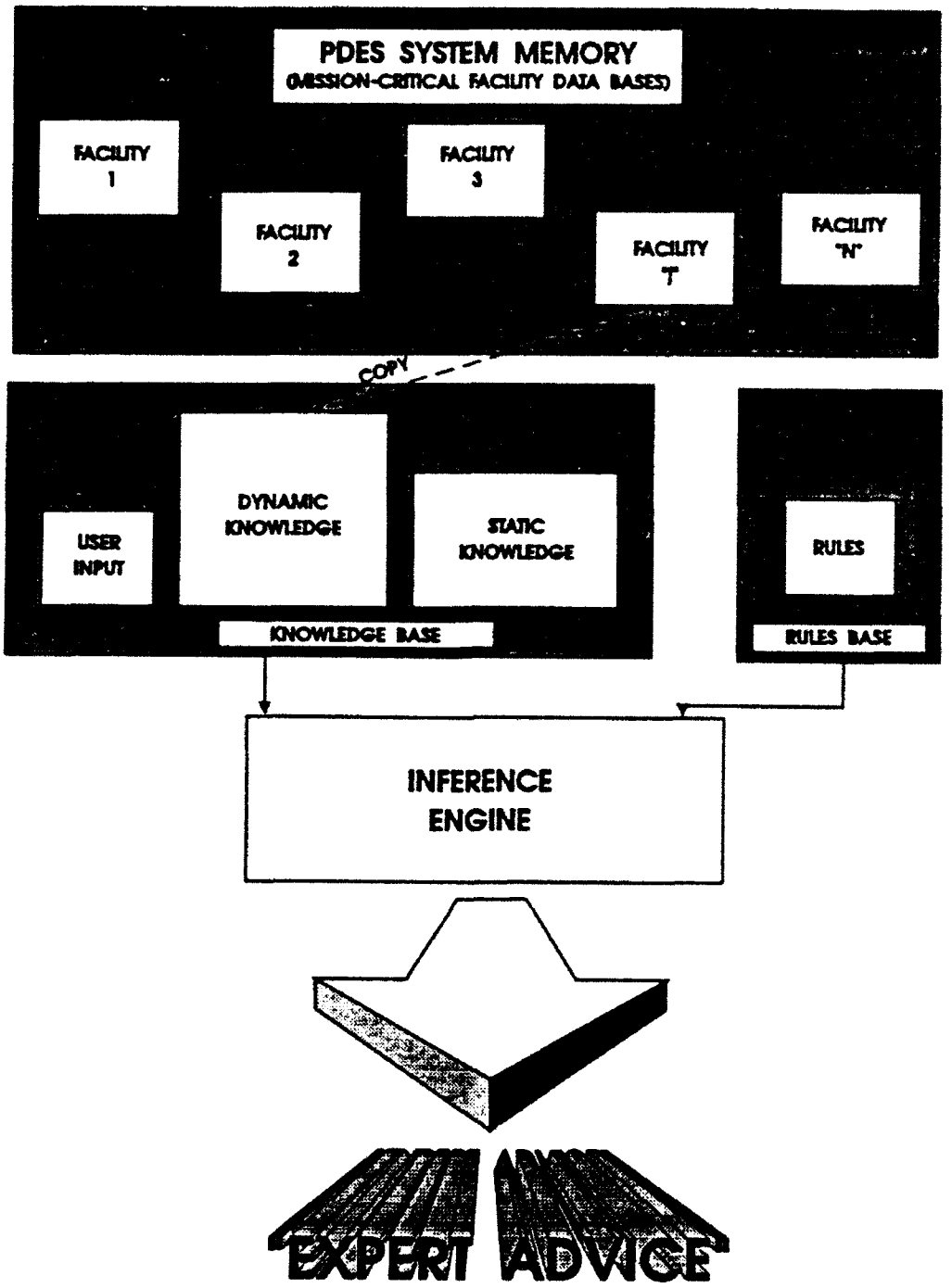


Figure 1.2. POST-DAM Expert System Schematic.

After the user enters a valid mission-critical element for assessment, the system asks for a description of the element's damage mode. For a given damage mode, PDES selects an expedient repair strategy from an array programmed within the system's rules base. The system then generates material, equipment, and manpower requirements for that strategy, based upon a combination of geometric properties obtained from the damaged element's knowledge base and user-entered damage dimensions. These resource requirements are stored in PDES data files, for transfer to the POST-DAM System host computer. The PDES data files are post-processed by the POST-DAM Relational Data Base Management System (RDBMS), the Harvard Project Manager (HPM), and the TED 1.1 Editor. The RDBMS, HPM, and TED Editor are discussed in References 2.2.3, 2.2.4, and 2.2.6, respectively.

The development of PDES involved creating a program which utilizes the phase-control firing of CLIPS rules within three logic levels. These logic levels can be understood most clearly when one thinks of the system as being analogous to three nested shells. Figure 1.3 represents this concept by showing three nested shells labeled PDES Environmental Level, Facility Specific Level, and Element Specific Level. These three shells represent the logical structure of PDES. A high-level representation of this PDES logic is shown in the Menu System Flow Chart presented in Figure 1.4. Source code for the PDES expert system and supporting batch jobs is given in Appendices A through G.

Upon activating PDES, the user enters the outermost or environmental level. From this level, the user can modify any PDES system setting. Also within this level PDES handles all file manipulation and communications. Within the second or facility specific level, the user tells PDES the facility number of the mission-critical structure to be assessed, and its general overall condition. The innermost or facility specific level is the largest of the three logic levels. Within this level the user assesses the damage to each damaged structural element within a damaged mission-critical facility. Inputs such as damage mode and damage dimensions are given by the user for each structural element being assessed. PDES processes the element-specific damage input, then selects the most appropriate expedient repair strategy within its knowledge base. Also within this level, PDES calculates the resources necessary to perform each selected expedient repair strategy. Instructions for descending and ascending through each logic level are found in Section 3.3.

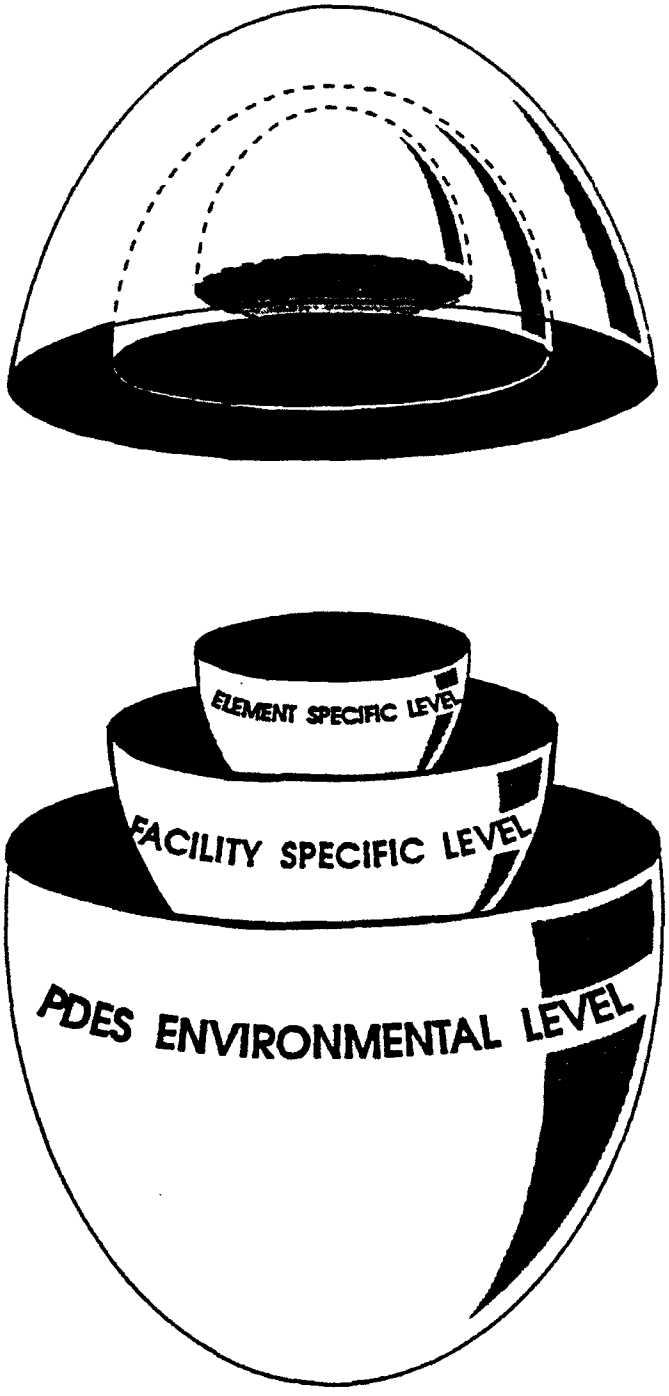


Figure 1.3. POST-DAM Expert System Nested Logic Levels.

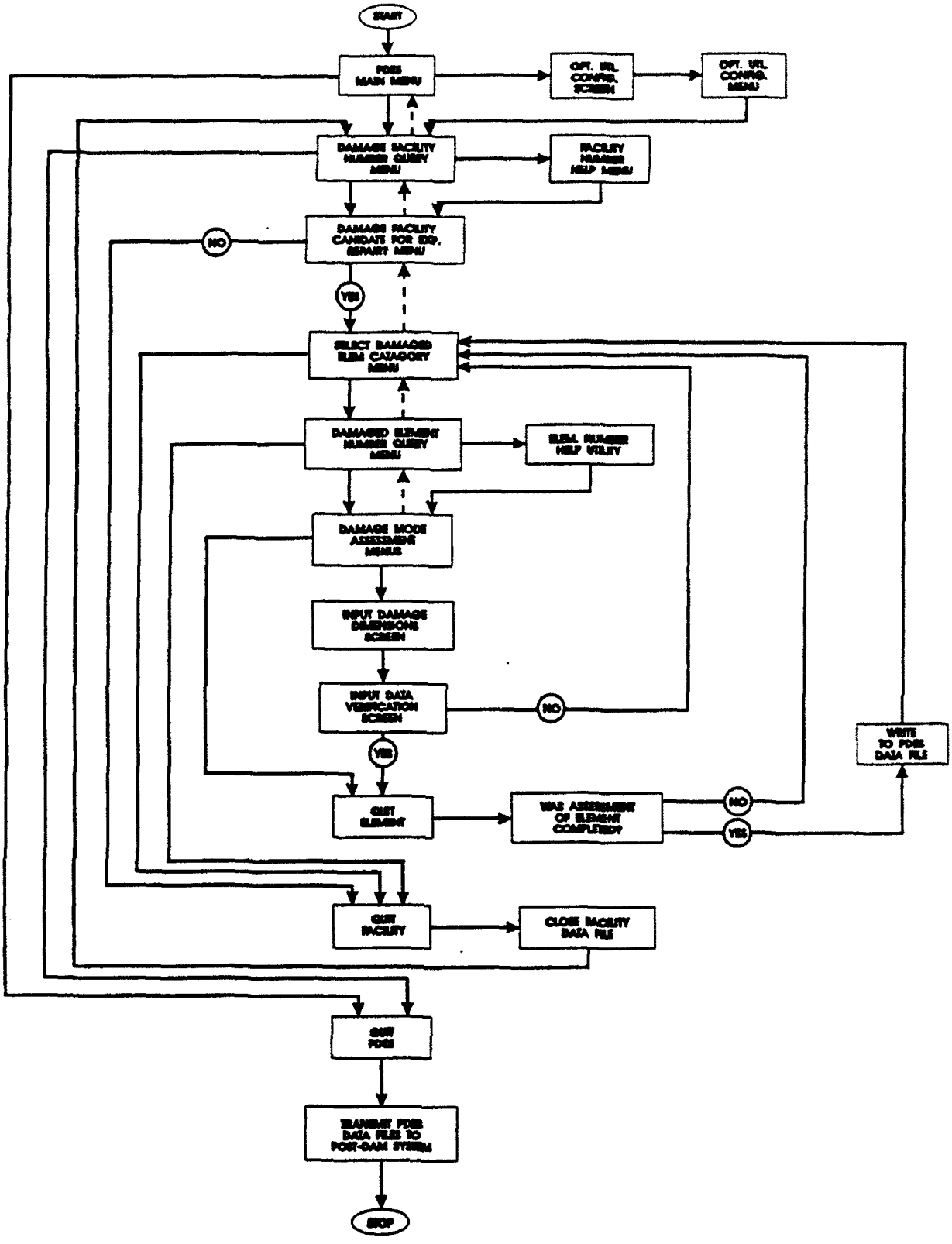


Figure 1.4. POST-DAM Expert System Menu System Flow Chart.

SECTION 2

REFERENCED DOCUMENTS

2.1 SETA CONTRACT SUBTASKS

2.1.1 Postattack Damage Assessment of Facilities, Subtask 2.02, Air Force Engineering and Services Center, SETA Contract F08635-88-C-0067, December 87.

2.1.2 Postattack Damage Assessment of Facilities, Subtask 2.02.1, Air Force Engineering and Services Center, SETA Contract F08635-88-C-0067, October 88.

2.1.3 Postattack Damage Assessment of Facilities, Subtask 2.02.2, Air Force Engineering and Services Center, SETA Contract F08635-88-C-0067, February 89.

2.1.4 Expedient Repair of Structural Facilities, Subtask 2.01, Air Force Engineering and Services Center, SETA Contract F08635-88-C-0067, December 87.

2.1.5 Expedient Repair of Structural Facilities, Subtask 2.01.1, Air Force Engineering and Services Center, SETA Contract F08635-88-C-0067, August 1989.

2.2 POST-DAM SYSTEM USER'S MANUALS

2.2.1 The POST-DAM System, Volume 1, Introduction to the POST-DAM System, Applied Research Associates, Inc., Report to AFESC/RDCS, March 91.

2.2.2 The POST-DAM System, Volume 3, Software User's Manual for DESQview 386, Applied Research Associates, Inc., Report to AFESC/RDCS, December 90.

2.2.3 The POST-DAM System, Volume 4, Software User's Manual for the Relational Data Base Management System (RDBMS), Applied Research Associates, Inc., Report to AFESC/RDCS, December 90.

2.2.4 The POST-DAM System, Volume 5, Software User's Manual for the Harvard Project Manager (HPM), Applied Research Associates, Inc., Report to AFESC/RDCS, December 90.

2.2.5 The POST-DAM System, Volume 6, Software User's Manual for Crosstalk Mk.4 on the Host Computer, Applied Research Associates, Inc., Report to AFESC/RDCS, December 90.

2.2.6 The POST-DAM System, Volume 7, Software User's Manual for the TED 1.1 Editor, Applied Research Associates, Inc., Report to AFESC/RDCS, December 90.

2.2.7 The POST-DAM System, Volume 8, Software User's Manual for Crosstalk Mk.4 on the Remote Computer, Applied Research Associates, Inc., Report to AFESC/RDCS, March 91.

2.2.8 The POST-DAM System, Volume 9, Field Manual of Mission-Critical Facilities for Use with the Prototype POST-DAM System, Applied Research Associates, Inc., Report to AFESC/RDCS, March 91.

2.3 HARDWARE AND SOFTWARE USER'S MANUALS

2.3.1 CLIPS Reference Manual, Version 4.3, Artificial Intelligence Section Lyndon B. Johnson Space Center, NASA, Document Number JSC-22948, July 1989.

SECTION 3

INSTRUCTION FOR USE

3.1 SYSTEM CONFIGURATION

The POST-DAM Expert System operates on a dedicated remote terminal, due to its intended use and the requirements of the contract under which it was developed. All software development and references to hardware and software descriptions assume PDES operates in this manner. To allow PDES to operate on a non-dedicated machine, additional software has been developed and included on the PDES System Diskette. Notation for this software, and documentation on its use, are presented in this manual at appropriate locations.

3.1.1 Hardware Requirements

PDES operates on any 286 or 386 IBM compatible microcomputer running MS-DOS (2.11 - 3.30) with 640K random access memory (RAM). Of the 640K RAM, a minimum of 570K must be accessible (free) to load and execute PDES. The computer system must also have a color or monochromatic monitor, a minimum of 2.0 megabytes of hard disk storage, and a 5.25-inch floppy disk drive. It must also have a 2400-baud, fully Hayes-compatible modem to transfer output files to the host computer.

The PDES version provided has been tested on both a 286 IBM compatible and a Wang 386 computer. The version operated properly when tested using MS-DOS 3.30, but failed to operate under MS-DOS 4.01. The problem encountered using DOS 4.01 was that too much of the 640K RAM was used by the operating system and its supporting files. This caused the expert system to experience memory allocation errors and fail to properly display the PDES system commands. If PDES experiences these types of errors under DOS 3.30 or lower, run the program PD_SYS discussed in Section 3.2.3.2.

3.1.2 Software Requirements

PDES operates using MS-DOS (2.11 - 3.30), plus files provided on the PDES System Diskette, and CROSSTALK Mk.4. The user is assumed to have a working knowledge of MS DOS, and should consult any of the various MS-DOS reference manuals if questions on the subject occur. CROSSTALK Mk.4 was chosen to communicate between PDES and the POST-DAM System operating on the host computer. Any communication package compatible with the software package running on the host computer could be substituted for CROSSTALK Mk.4, but minor modifications to the DOS batch job PD.BAT (see Section 3.3) would then be necessary. A discussion of the installation and use of CROSSTALK Mk.4 is provided in Reference 2.2.7.

The PDES System Diskette contains a number of files necessary to operate PDES. These files, differentiated by extension type, are listed below.

* .EXE executable file(s):

CLIPS.EXE	CLIPS Version 4.20 interpreter. Contains the compiled version of the basic CLIPS system and its extended math functions.

* .CLP CLIPS Language source code file(s):

PD.CLP	Expert System source code. Contains the ARA-developed POST-DAM Expert System.

* .BAT DOS batch file(s):

PD.BAT	Controls operation of POST-DAM Expert System.
PD_SYS.BAT	Sets up PDES environment.
PD_NOSYS.BAT	Restores original (non-PDES) environment.
PD_NSTAL.BAT	Installs the PDES System.

* .RUN slave file(s):

PD.RUN	Called by PD.BAT.

* .PD text file(s) called by PD.CLP:

PDES_ON.PD	PDES compilation screen.
LOGON.PD	PDES Log-on banner.
LOGOFF.PD	PDES Log-off banner.
SETUP_1.PD	Setup Screen Number 1.
SETUP_2.PD	Setup Screen Number 2.
HELP_1.PD	Help Screen Number 1.
MENU_1.PD	Menu Screen Number 1.
MENU_2.PD	Menu Screen Number 2.
MENU_2H.PD	Menu Screen Number 2 (with help option).
MENU_3.PD	Menu Screen Number 3.
MENU_4.PD	Menu Screen Number 4.
MENU_5.PD	Menu Screen Number 5.
MENU_5H.PD	Menu Screen Number 5 (with help option).
MENU_6B.PD	Menu Screen Number 6 (beam elements).
MENU_6C.PD	Menu Screen Number 6 (column elements).
MENU_6D.PD	Menu Screen Number 6 (door elements).
MENU_6EW.PD	Menu Screen Number 6 (exterior wall elements).
MENU_6F.PD	Menu Screen Number 6 (floor elements).
MENU_6IW.PD	Menu Screen Number 6 (interior wall elements).
MENU_6M.PD	Menu Screen Number 6 (miscellaneous elements).
MENU_6R.PD	Menu Screen Number 6 (roof elements).
MENU_7.PD	Menu Screen Number 7.
COMM_1.PD	PDES Communication Menu #1.
COMM_2.PD	PDES Communication Menu #2.
CONFIG.PD	PDES CONFIG.SYS file.
AUTOEXEC.PD	PDES AUTOEXEC.BAT file.

* .DAT Data file(s) loaded into the PDES Dynamic Knowledge Base:

BITBURG.DAT	List of mission-critical facilities at Bitburg AB, Germany.
BLDG138.DAT	Structural data base on Bitburg mission-critical Facility 138.
BLDG464.DAT	Structural data base on Bitburg mission-critical Facility 464.
BLDG4058.DAT	Structural data base on Bitburg mission-critical Facility 4058.
BLDG9999.DAT	Structural data base on Tyndall NATO structure at the SKY-10 testing facility. Structure assumed to be a mission-critical structure at Bitburg AB for PDES testing purposes.
BLDG1.DAT	Structural data base on imaginary Bitburg mission-critical facility. Data file used for PDES testing purposes.
BLDG2.DAT	Structural data base on imaginary Bitburg mission-critical facility. Data file used for PDES testing purposes.
BLDG3.DAT	Structural data base on imaginary Bitburg mission-critical facility. Data file used for PDES testing purposes.
BLDG4.DAT	Structural data base on imaginary Bitburg mission-critical facility. Data file used for PDES testing purposes.
BLDG5.DAT	Structural data base on imaginary Bitburg mission-critical facility. Data file used for PDES testing purposes.

3.2 GETTING STARTED

This section explains the procedures for installing the PDES software, and for setting up or changing the computer operating environment. Several MS-DOS commands and files are mentioned in this section (e.g., PATH, CONFIG.SYS, AUTOEXEC.BAT). If the user is unfamiliar with any of the procedures discussed, consult an MS-DOS manual for instructions. Execute the following steps to get PDES up and running:

1. Back up the system diskette (see Section 3.2.1).

2. Check the system diskette contents to verify that all PDES software files are present (see Section 3.1.2).

3. Verify the computer's hardware configuration (see Section 3.1.1).

4. Run the PD_NSTAL program to install the PDES software (see Section 3.2.2).

5. Set up the PDES Environment (see Section 3.2.3).

3.2.1 Backing Up the PDES System Diskette

Before installing PDES on your computer, make a working copy of the system diskette, using the DISKCOPY utility supplied with MS-DOS. Save the original system diskette for backup, and use the working copy where the system diskette is referenced.

3.2.2 Installing PDES on the Computer System's Hard Disk

To install PDES onto the computer's hard disk, it is necessary to run the file PD_NSTAL.BAT. This file is an MS-DOS batch job, which creates all directories necessary for PDES, and copies the PDES software into appropriate directories. **WARNING! The file PD_NSTAL.BAT assumes your computer presently does not have a directory named c:\postdam.** If such a directory presently exists, PD_NSTAL.BAT will overwrite any existing files that have the same filename as a PDES software filename. If the directory name c:\postdam does already exist and is impossible to change, it will be necessary to modify all references to c:\postdam in the PDES files PD_NSTAL.BAT, PD.BAT, PD.CLP, and AUTOEXEC.PD.

To run the PD_NSTAL.BAT file, the user will need to execute the following steps:

1. Insert the PDES system diskette into the computer's A drive.

2. Switch to drive A by entering, at the current prompt, the command

   A:

3. Upon entering the above DOS command, the prompt **A:\ >** should appear. At this prompt the user should enter the command

   PD_NSTAL

Installation of the PDES system proceeds under the control of the PD_NSTAL program. If, during execution, the process needs to be terminated, PD_NSTAL can be exited as follows:

1. Hit the following two keys simultaneously

   [CTRL] [BREAK]

2. DOS will respond with the query

   Terminate batch job (Y/N)?

3. To this query the user should enter option

   Y

Upon successful completion of the program PD_NSTAL, all PDES software files will have been transferred from the PDES system diskette into their appropriate directories on the computer's C: drive. The directory tree for drive C: should now have branches as shown in Figure 3.1. PD_NSTAL will have returned control to DOS, and the prompt

C:\POSTDAM >

should appear. If this prompt is not displayed, it may be that the DOS PROMPT command has never been executed, or is configured to yield some other prompt. The user may issue the DOS command

dir

at the current prompt, to verify that C:\POSTDAM is the current directory.

3.2.3 Setting Up the PDES CONFIG.SYS and AUTOEXEC.BAT

PDES was developed assuming it would run alone on a dedicated personal computer. It is understood, though, that there may be instances where this assumption is not valid. Therefore the following two sections provide instruction on the procedures for installing CONFIG.SYS and AUTOEXEC.BAT on systems that are solely dedicated to PDES, and on systems where other software packages exist.

3.2.3.1 Computer Systems Dedicated to PDES

If the computer system on which PDES has been installed is dedicated solely for PDES's use, execute the following steps to load the PDES CONFIG.SYS and AUTOEXEC.BAT files. These steps need only be performed the first time PDES is installed.

1. Go to the computer system's root directory by entering, at the current prompt, the DOS command

   CD

2. Copy the PDES file CONFIG.PD into the root directory, and change its name to CONFIG.SYS by entering the DOS command

   COPY C:\PD_SYSTM\CONFIG.PD CONFIG.SYS

   NOTE: ANY DEVICE NEEDED TO OPERATE A PARTICULAR MACHINE MUST BE ADDED TO THE FILE CONFIG.PD.

3. Copy the PDES file AUTOEXEC.PD into the root directory, and change its name to AUTOEXEC.BAT by entering the DOS command

   COPY C:\PD_SYSTM\AUTOEXEC.PD AUTOEXEC.BAT

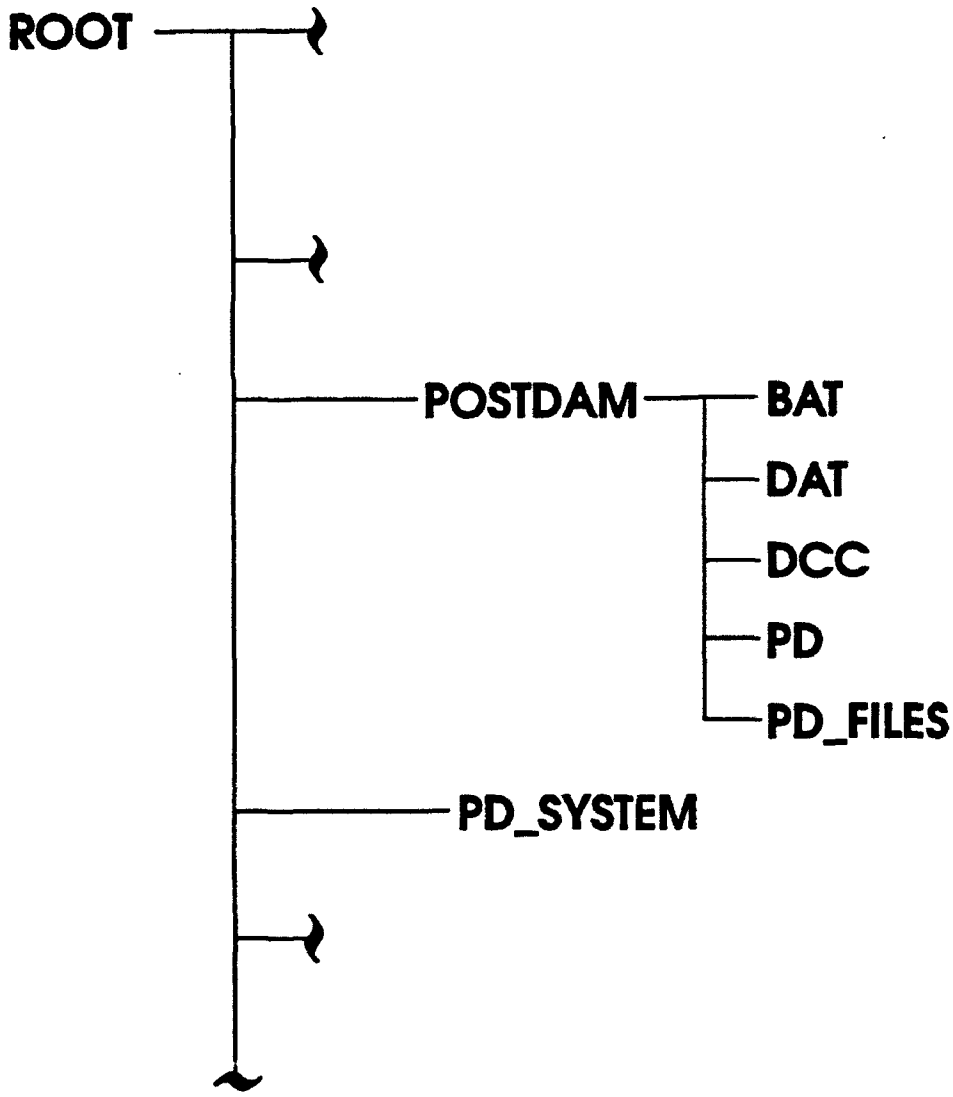


Figure 3.1. POST-DAM Expert System Installation Directory Tree.

4. After the new CONFIG.SYS and AUTOEXEC.BAT files have been added to the system's root directory, reboot the system so the new settings will take effect. To reboot the system hit the

   [CTRL] [ALT] [DEL]

   keys simultaneously.

3.2.3.2 Computer Systems Not Dedicated to PDES

Two PDES files were created to assist in installing PDES on computer systems which are not dedicated to running only PDES. These two files are named PD_SYS.BAT and PD_NOSYS.BAT, and are loaded in the directory C:\PD_SYSTM. The purposes of these two files are as follows:

PD_SYS.BAT	Writes the PDES files CONFIG.PD and AUTOEXEC.PD into the root directory under the filenames CONFIG.SYS and AUTOEXEC.BAT. The original files CONFIG.SYS and AUTOEXEC.BAT are temporarily saved under the filenames CONFIG.TMP and AUTOEXEC.TMP, in the directory C:\PD_SYSTM. ** **WARNING** ** ANY DEVICE NEEDED TO OPERATE A PARTICULAR MACHINE MUST BE ADDED TO CONFIG.PD.
PD_NOSYS.BAT	Erases the PDES CONFIG.SYS and AUTOEXEC.BAT files, and returns the original (non-PDES) CONFIG.SYS and AUTOEXEC.BAT files to the root directory.

To toggle back and forth between the PDES environment and the environment used for the other software packages installed on the personal computer, the procedure described below must be followed before each PDES run sequence.

1. Change from the current directory to the directory C:\PD_SYSTM by entering the DOS command

   CD C:\PD_SYSTM

2. Run the PDES file PD_SYS.BAT by entering the command

   PD_SYS

3. Reboot the computer system by simultaneously hitting the keys

   [CTRL] [ALT] [DEL]

Upon completion of rebooting, the computer system should be in the PDES environmental mode.

Before the computer system can operate under the original (non-PDES) environment, the PDES file PD_NOSYS.BAT must be run. Therefore, always execute the following procedure when leaving the PDES environment.

1. Change from the current directory to the directory C:\PD_SYSTM by entering the DOS command

   CD C:\PD_SYSTM

2. Run the PDES file PD_NOSYS.BAT by entering the command

   PD_NOSYS

3. Reboot the computer system by simultaneously hitting the keys

   [CTRL] [ALT] [DEL]

Upon completion of rebooting, the computer system should be in the original (non-PDES) environmental mode.

3.3 RUNNING PDES

The POST-DAM Expert System consists of several text, data, source code, and executable files (see Section 3.1.2). This is necessary for the system to be useful, user friendly, and memory-sensitive. A PDES batch job was developed to handle the management, compilation, and communications involved with numerous files. The procedure for running this batch job, is discussed in the following three sections, along with procedures for using the PDES menu systems and for communicating with the host computer.

3.3.1 Starting PDES

To simplify the task of running PDES, a DOS batch job was developed (reference Appendix B) to load and run all necessary files. Therefore, after installing PDES and the PDES system environment on the hard disk (see Section 3.2.2 and Section 3.2.3, respectively), the user may run PDES by executing the following steps:

1. Change from the current directory to the directory C:\POSTDAM, by entering, at the current prompt, the DOS command

   CD C:\POSTDAM

2. Run the PDES batch job PD.BAT by entering, at the prompt, the command

   PD

Execution of the PD.BAT file gathers all necessary PDES text and data files. During this time the user will observe a series of screen clears and DOS command echoes on the computer system's display terminal. Also, executing PD.BAT causes the CLIPS source code file PD.CLP to be loaded and run by the CLIPS interpreter CLIPS.EXE. During compilation of PD.CLP by the interpreter, the user will see on the display terminal the CLIPS Version number, followed on the next line by a "$" and a "*" series similar to that shown in Figure 3.2. These symbols indicate that PD.CLP is compiling normally. Once PD.CLP has compiled,

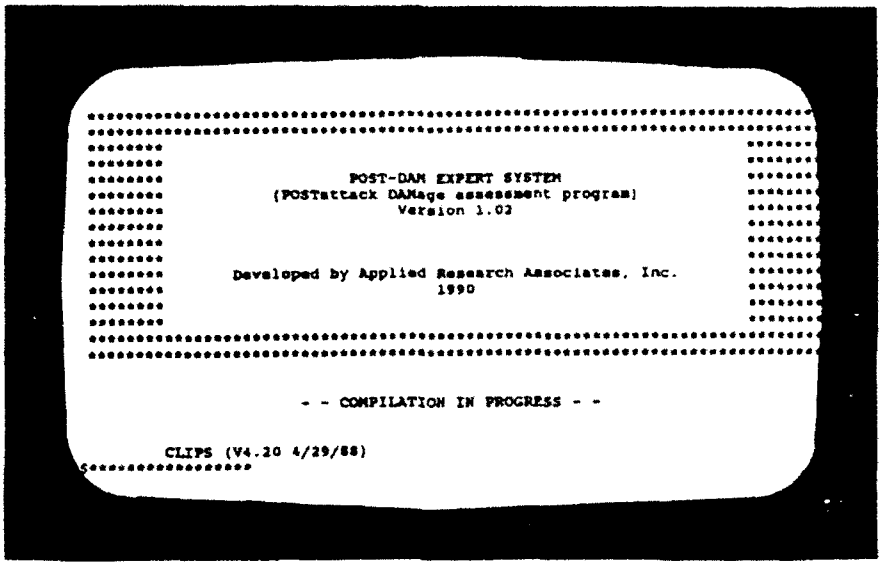


Figure 3.2. POST-DAM Expert System Compilation Screen.

control of the PDES system changes from the batch job PD.BAT to the compiled expert system program PD.CLP. Section 3.3.2 discusses the interaction between the user and PDES during the interactive session.

3.3.2 Using the PDES Menu System

PDES's inference engine, comprised of its intricate rules and knowledge bases, results in an expert system with a complex decision tree (Figure 1.4). A highly interactive, multilevel, menu-driven system guides the user through PDES's extensive decision-making process. This system, with its error-detection routines, guides the user from menu to menu until PDES has enough information to deliver "Expert Advice" to the POST-DAM System residing on the host computer (Figure 1.1).

To demonstrate the complexities of the PDES menu systems, a graphical representation of the connectivity between menus in one possible PDES menu system is given in Figure 3.3. This menu system shows the path taken to assess a mission-critical exterior wall, damaged by excessive cracking. An assessment of a different category of element and/or damage would involve slightly different menus and menu connectivity. Also, modifying the Optional Utility Environment (see Section 3.3.2.1.2) may cause variation in menus and/or menu format. All menus presented in Figure 3.3, and throughout this manual, can be obtained with the Optional Utility Environment in its system default configuration.

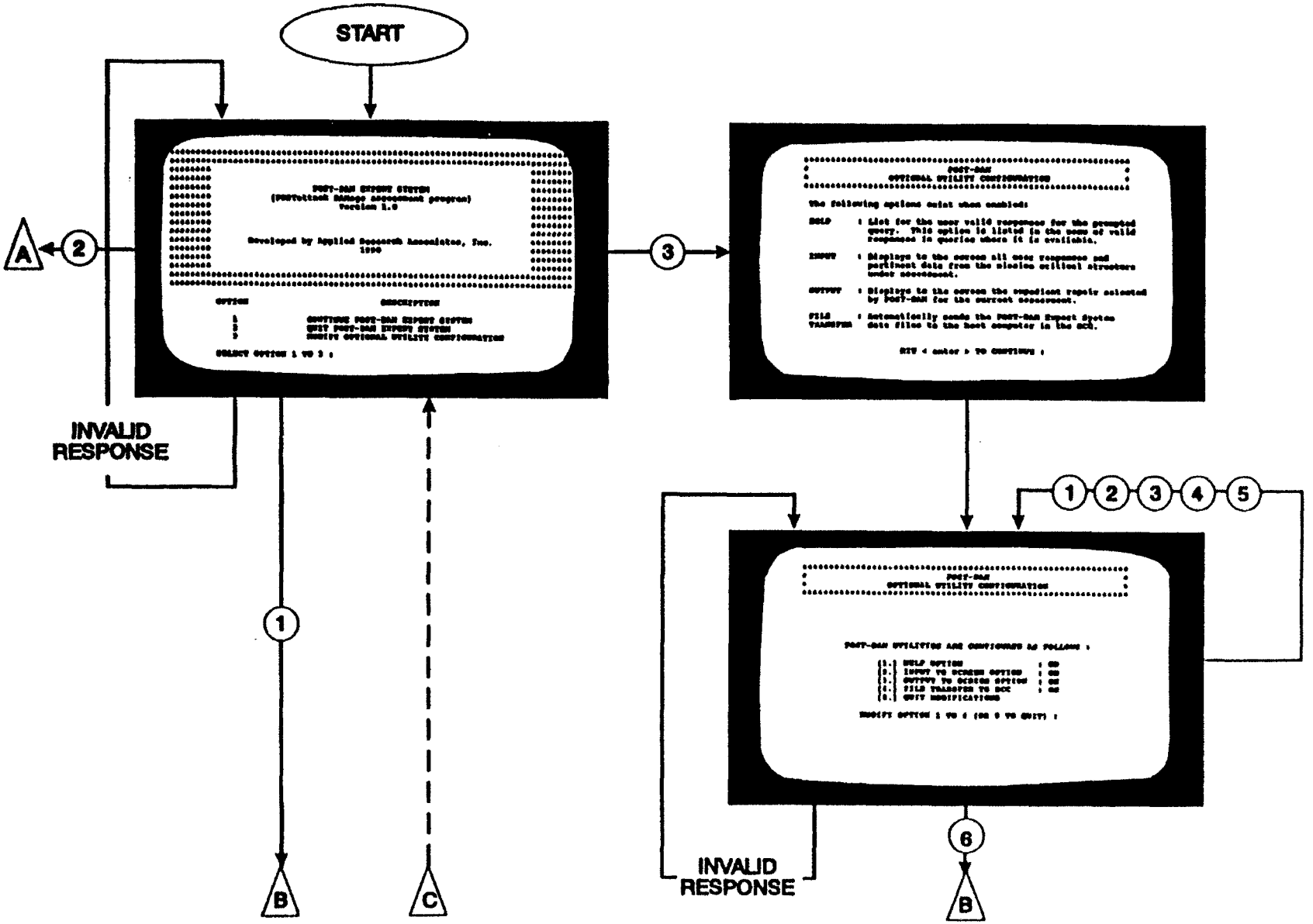


Figure 3.3. POST-DAM Expert System Menu System Connectivity.

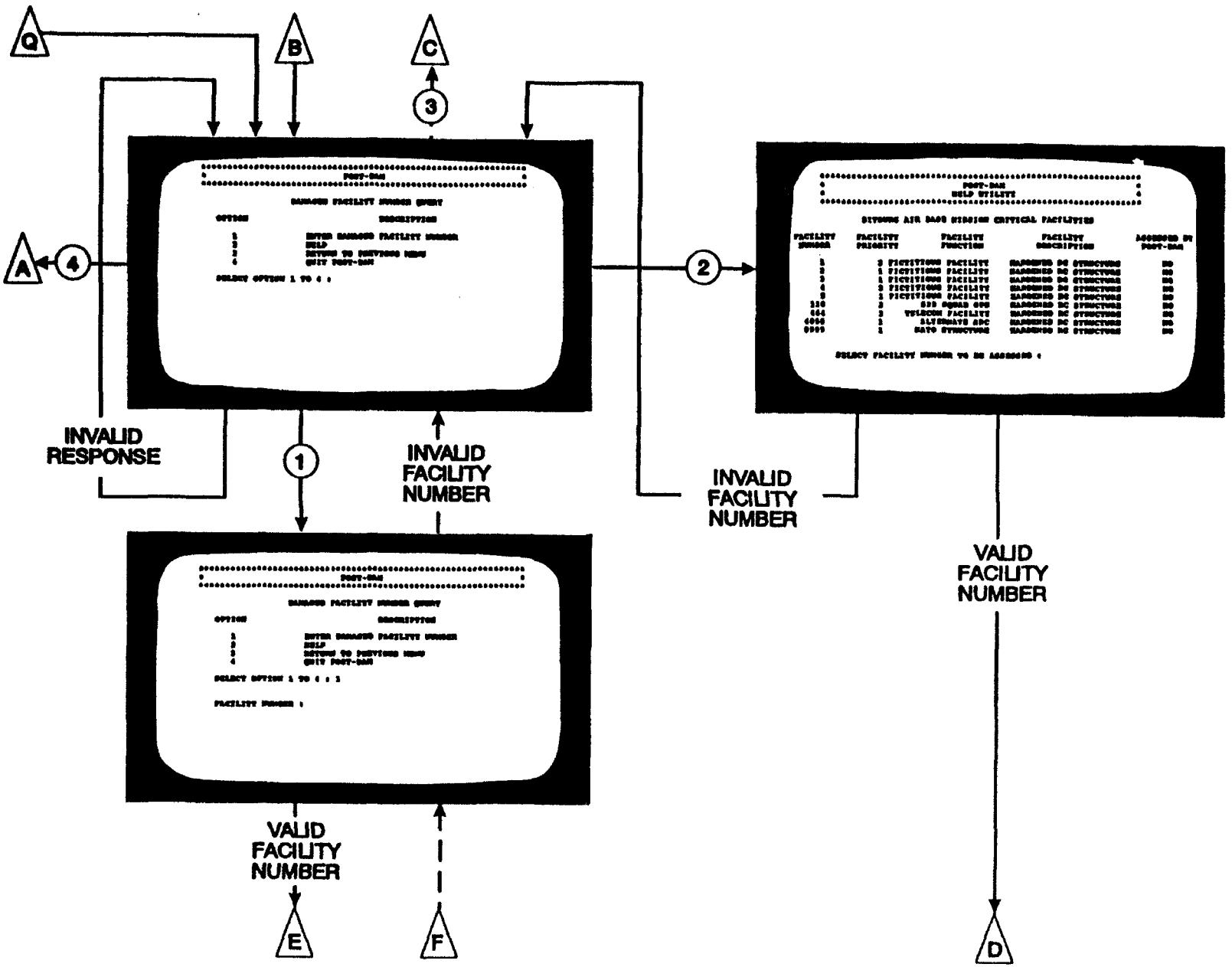


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

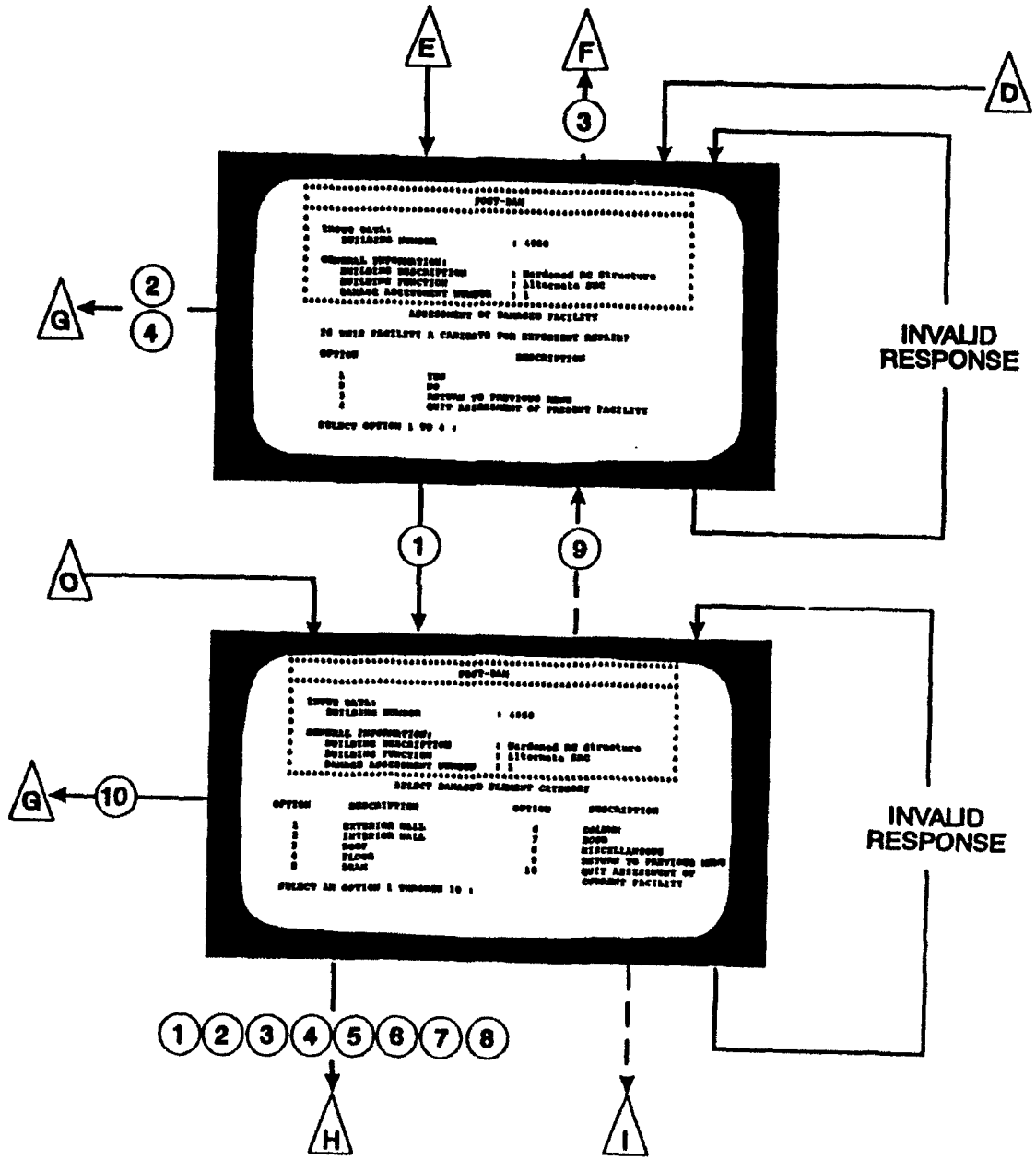


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

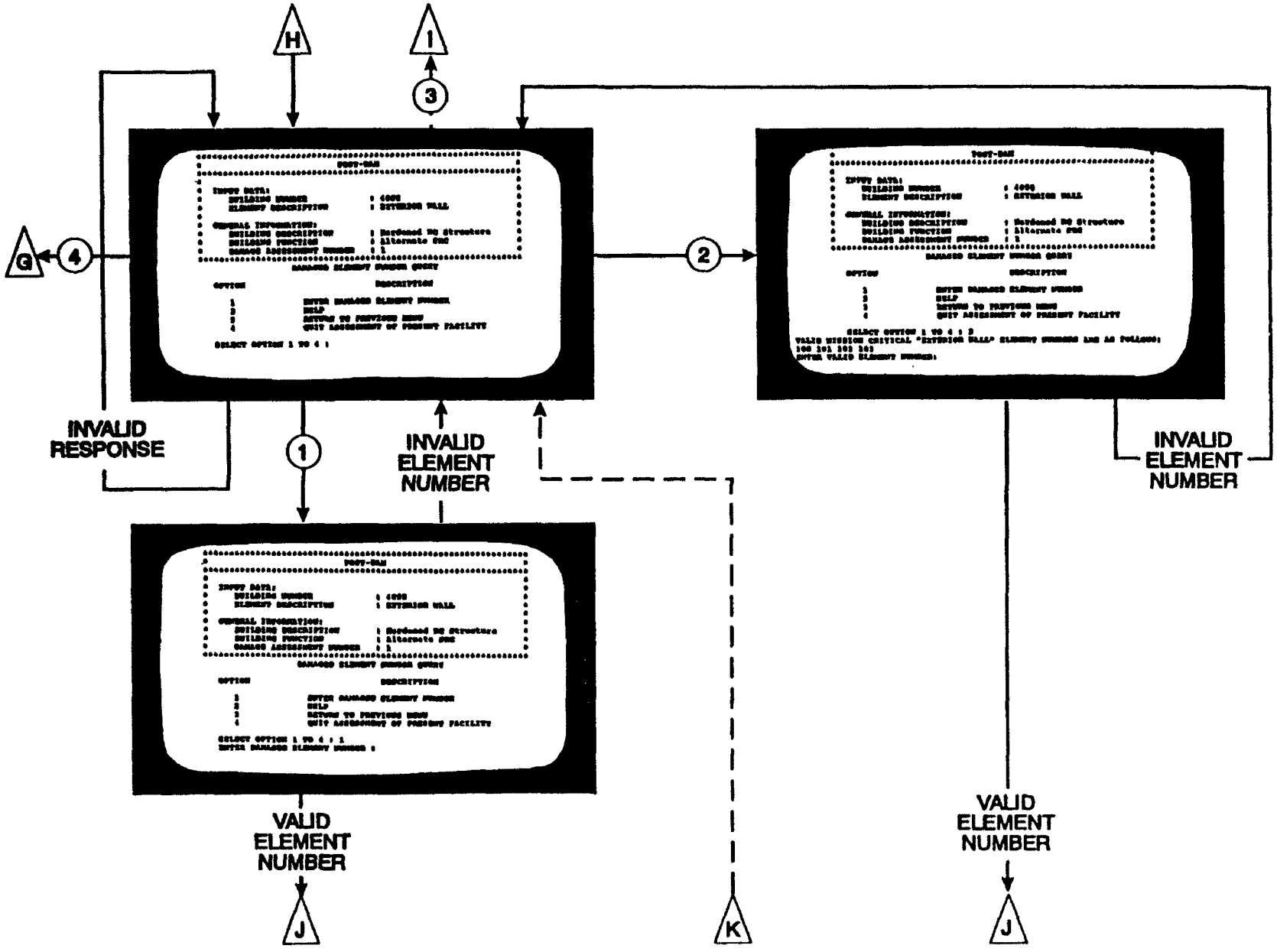


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

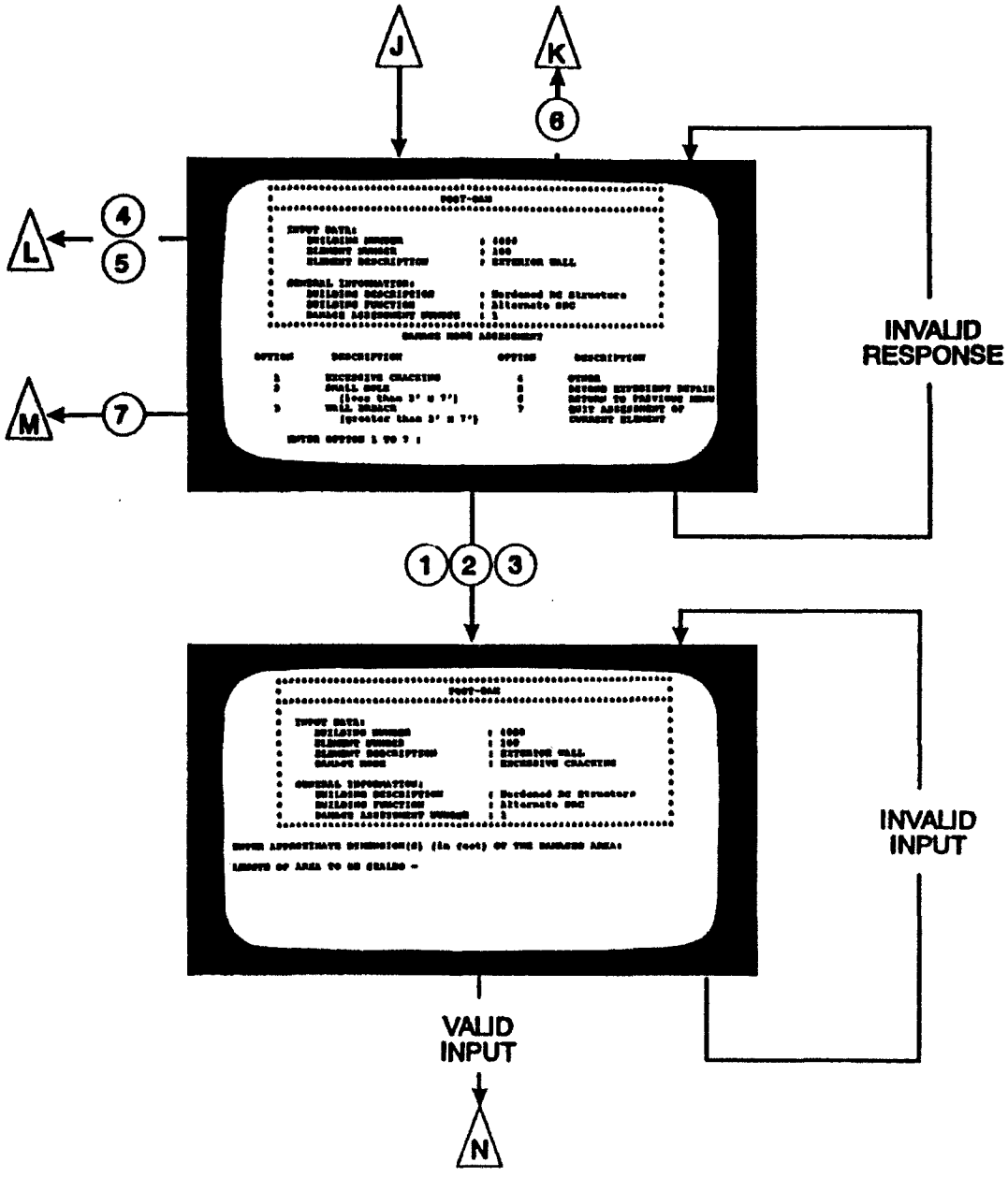


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

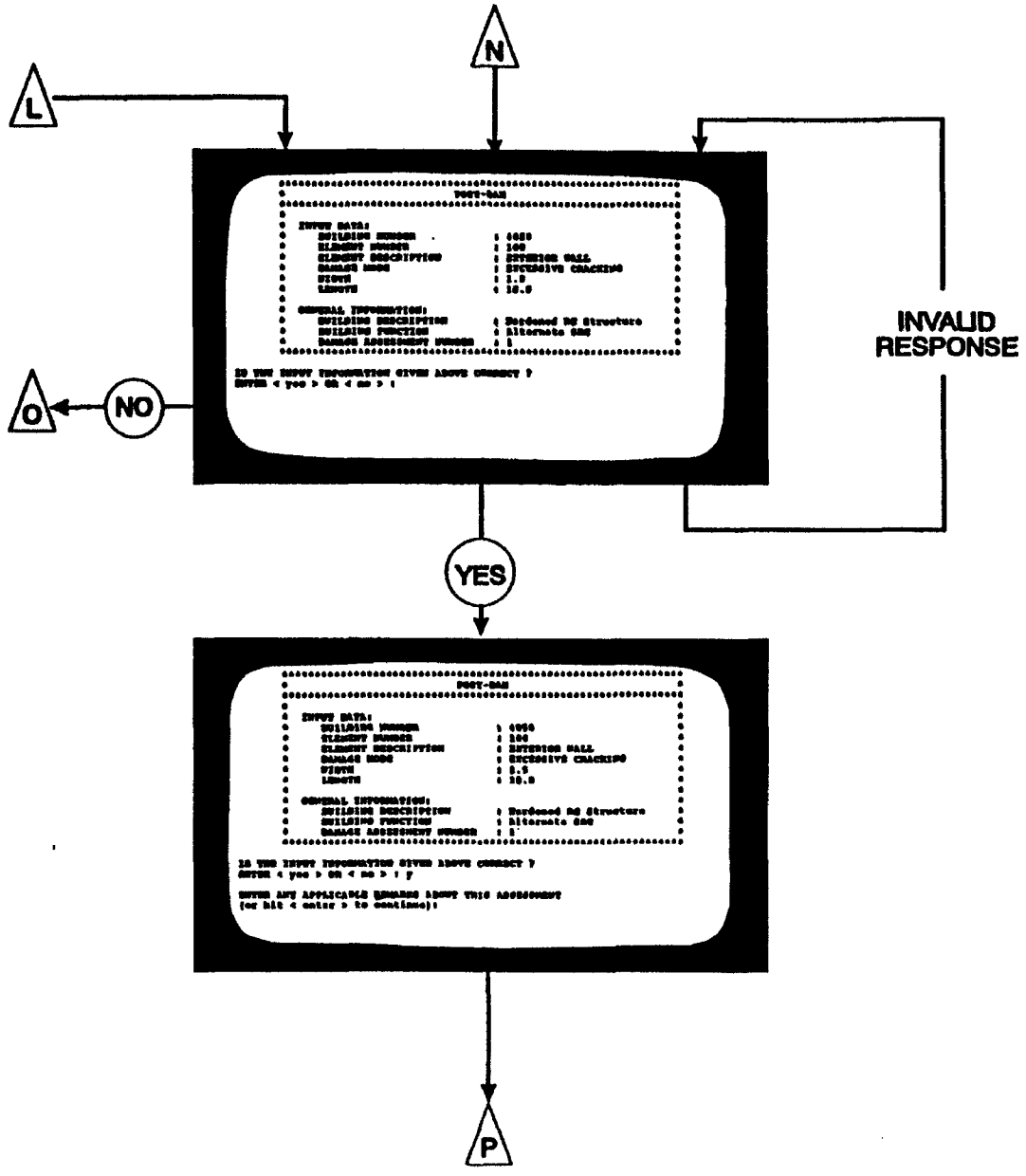


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

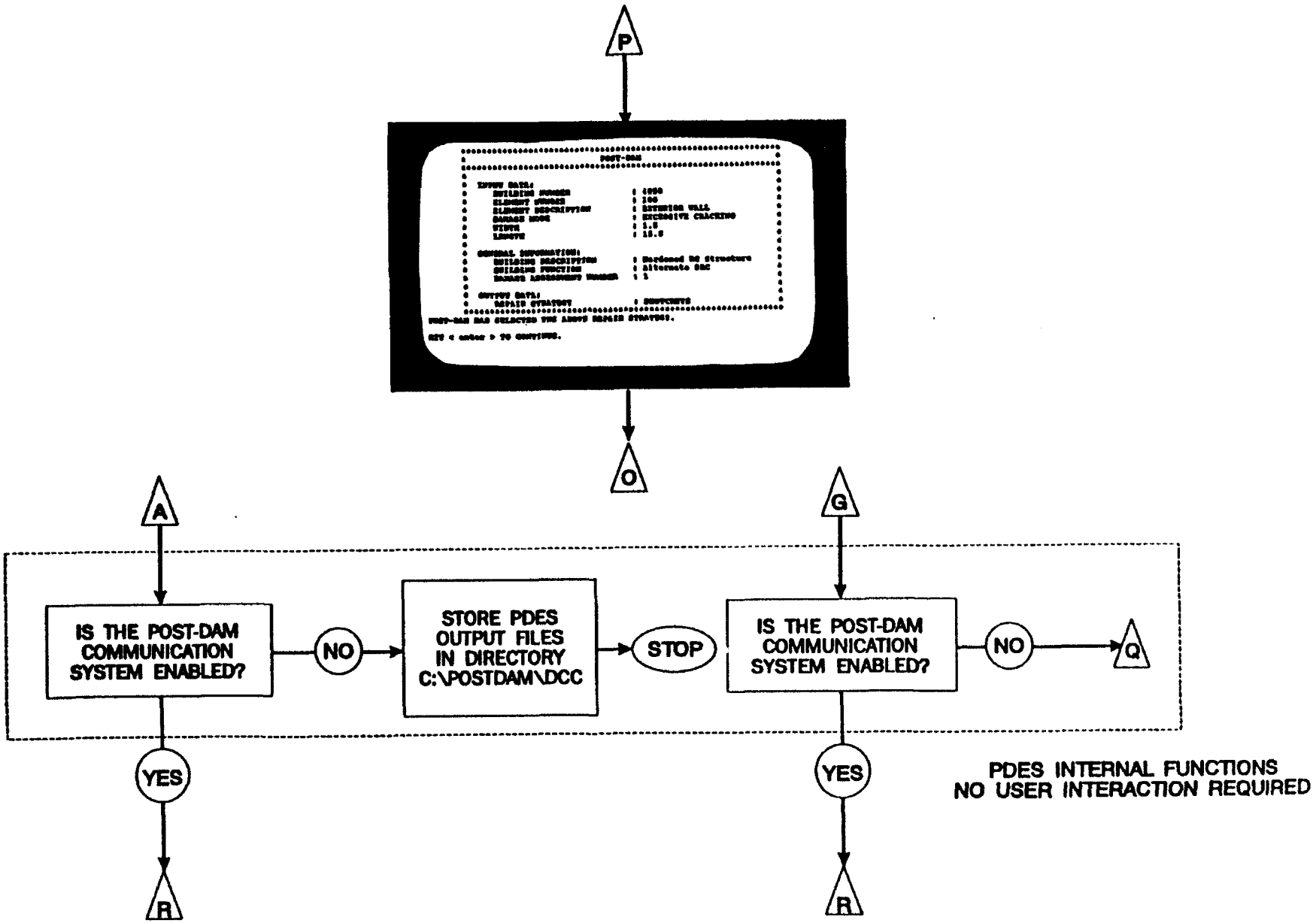


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Continued).

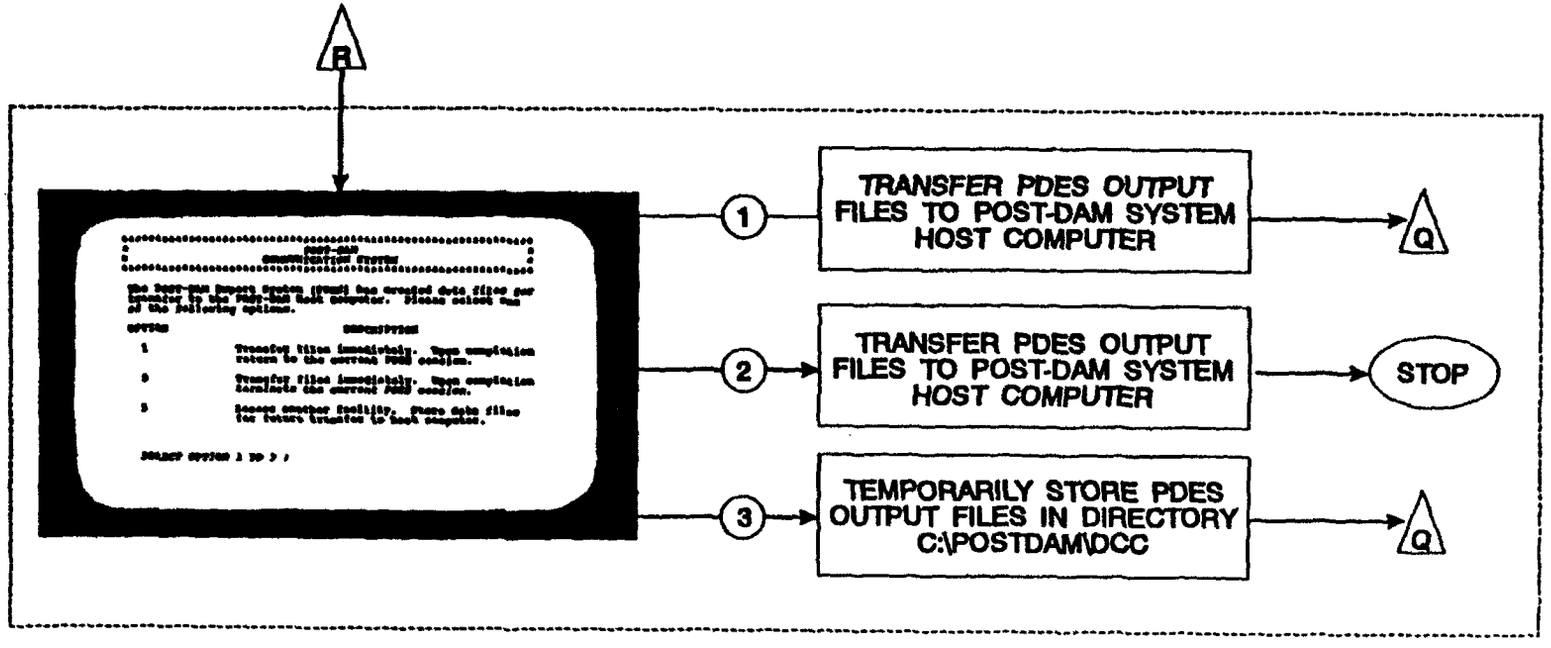


Figure 3.3. POST-DAM Expert System Menu System Connectivity (Concluded).

As shown in Figure 3.3, there are too many paths the user might take within a PDES session to expand upon them all in this manual. Therefore, this section documents the three PDES logic (decision making) levels (Figure 1.3), and discusses the various PDES menus within each level. The user should consult Figure 3.3 while reading the following sections, to obtain an overall understanding of the PDES menu system and its underlying logic.

3.3.2.1 Environmental Level

The first level the user enters upon executing PDES is the environmental level. Within this level the PDES system handles all external file maintenance, plus communication with the host computer. The user can also modify the PDES system defaults while within this level. The following four sections discuss the various menus available within the PDES Environmental Level.

3.3.2.1.1 PDES Main Menu

To enter the PDES environmental level (Figure 1.3), the user must first run the PDES batch job PD.BAT discussed in Section 3.3.1. Upon completing the procedure discussed in Section 3.3.1, the user will see on the display screen the PDES logon banner and main menu shown in Figure 3.4. From the PDES main menu, the user may choose to either continue normal PDES operation, terminate the PDES session, or modify the PDES utility configuration. Discussions of each main menu option are presented below.

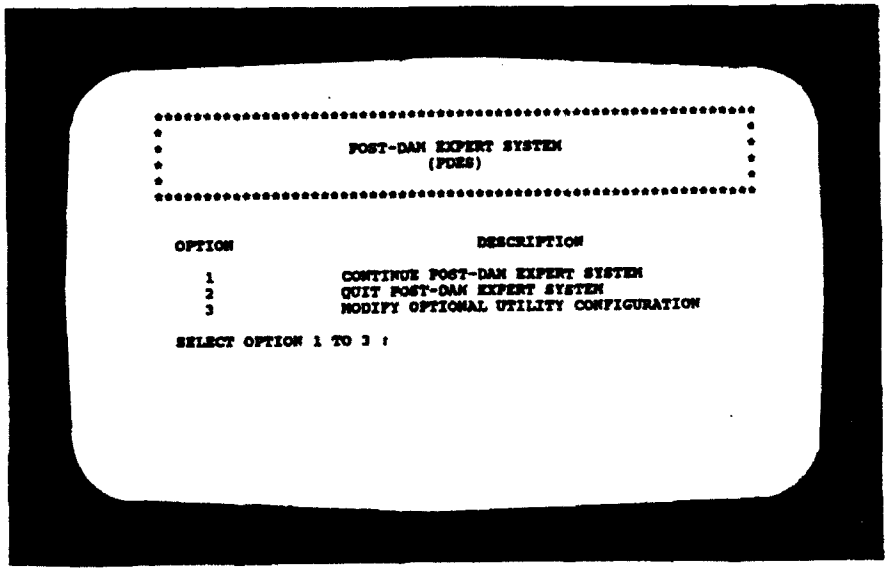


Figure 3.4. POST-DAM Expert System Main Menu.

OPTION 1

Option 1 should be selected if a damaged, mission-critical facility is to be assessed. Selecting Option 1 causes the airbase mission-critical facilities header file (see Section 3.5.2.1) to be loaded into the PDES dynamic knowledge base. In the examples shown here, Bitburg AB is used. Section 3.3.2.1.3 discusses the PDES Menu that results from selecting Option 1, as well as explaining the process of entering a facility number.

OPTION 2

Option 2 should be selected from the menu shown in Figure 3.4 if the user wishes to terminate the PDES session. Discussion of a normal PDES session termination is given in Section 3.3.2.1.5.

OPTION 3

Option 3 allows modifications to the PDES Optional Utility Configuration default settings. Discussion of the optional utilities and their default settings is given in Section 3.3.2.1.2.

3.3.2.1.2 Modifying the Optional Utility Configuration

PDES was developed with several optional utilities. These utilities provide the user with a variety of help, screen displays, and file transferring capabilities. A list of the PDES optional utilities, and a description of their functions are given below.

HELP	Lists valid responses for the prompted query. This option is listed in a PDES menu when available.
INPUT	Displays on the screen pertinent data from the mission-critical facility under assessment, and echoes all user responses to PDES queries.
OUTPUT	Displays on the screen the expedient repair strategy selected by PDES.
FILE TRANSFER	Automatically sends all PDES output files (.OUT, .EQP, and .MAT files) to the designated host computer.

The user may enable or disable any of the above optional utilities by executing the steps given below.

1. Select Option 3 from the PDES Main Menu shown in Figure 3.4.

2. Executing Step 1 displays the PDES Optional Utility Configuration screen shown in Figure 3.5. This screen lists the optional utilities available to the PDES user. To proceed further, the user must press the [Enter] key as instructed on the screen, which displays the Optional Utility Configuration menu shown in Figure 3.6.

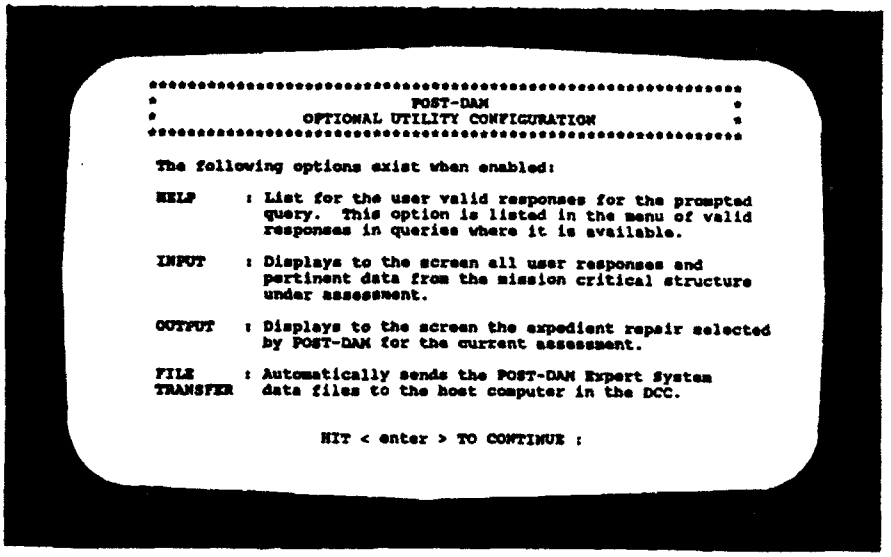


Figure 3.5. POST-DAM Expert System Optional Utility Configuration Screen.

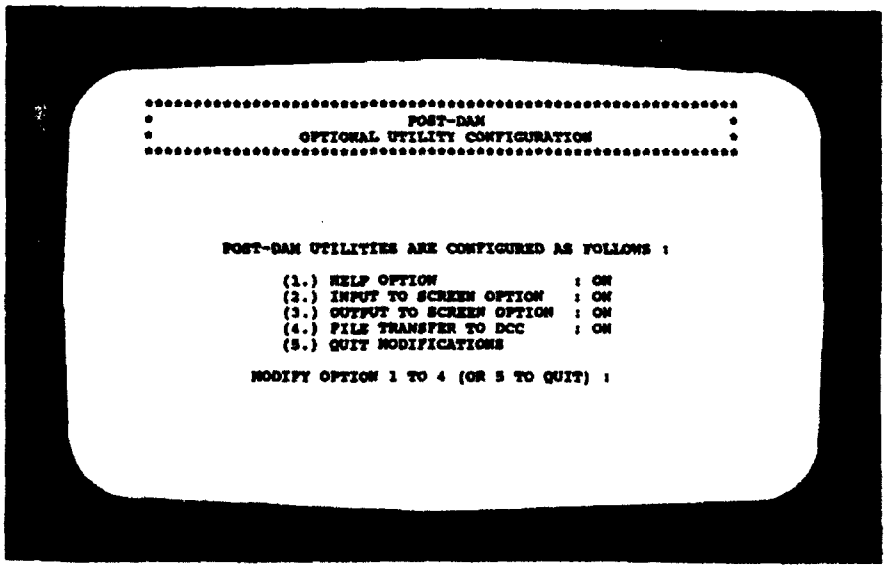


Figure 3.6. POST-DAM Expert System Optional Utility Configuration Menu.

3. To modify one of the Utility Configuration settings, the user is instructed to **select the option number** (Option 1 through 4) corresponding to the utility to be toggled on or off.

4. The Optional Utility Configuration menu refreshes itself each time the user modifies an option. The user can make more modifications to the optional utility configuration menu by **repeating Step 3.** Once the user is satisfied with the configuration, the optional utility configuration menu settings can be saved, and the menu exited by **selecting Option 5** ("quit").

Selecting Option 5 of the Optional Utility Configuration menu (Figure 3.6) saves the currently displayed settings, and displays the PDES Menu discussed in Section 3.3.2.1.3.

3.3.2.1.3 Entering a Damaged Facility Number

To assess damage to a mission-critical facility, the user must tell PDES the facility number, so PDES can load that facility's specific data files into its dynamic knowledge base (see Section 3.5.2). The user must select one of the four options from the Damaged Facility Number Query menu shown in Figure 3.7. A discussion of each option is given below.

OPTION 1

If the number of the facility to be assessed is known, select Option 1. Upon entering Option 1, the user is instructed to enter the facility number, as shown in Figure 3.8. Entering a valid, mission-critical facility number opens the three facility-specific PDES data files (.OUT, .EQP, and .MAT) discussed in Section 3.4. The Assessment of Damaged Facility menu discussed in Section 3.3.2.2.1, is then displayed on the screen.

OPTION 2

If general information on valid, mission-critical facilities is desired (and the HELP utility is enabled), select Option 2. Entering Option 2 displays the Mission-Critical Facility Help menu, discussed in Section 3.3.2.1.4.

OPTION 3

If the user decides the menu shown in Figure 3.7 was arrived at in error, or that further modification to the Optional Utility Configuration is needed, select Option 3. Selecting Option 3 returns the user to the PDES main menu shown in Figure 3.4. The user is urged to read Section 3.3.2.4, entitled "Returning to a Previous PDES Menu," to completely understand the operation of returning to a previous menu.

OPTION 4

If the user wishes to terminate the PDES session, select Option 4. Section 3.3.2.1.5 discusses normal termination of a PDES session.

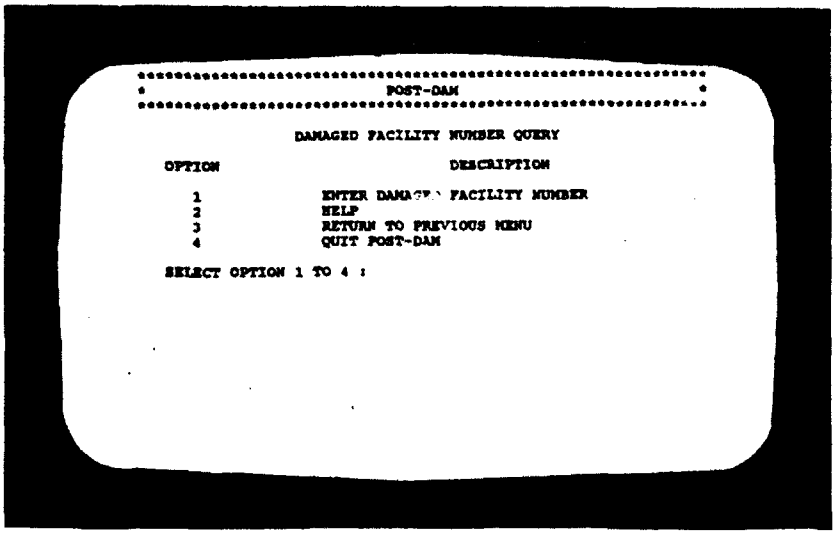


Figure 3.7. POST-DAM Expert System Damaged Facility Number Query Menu.

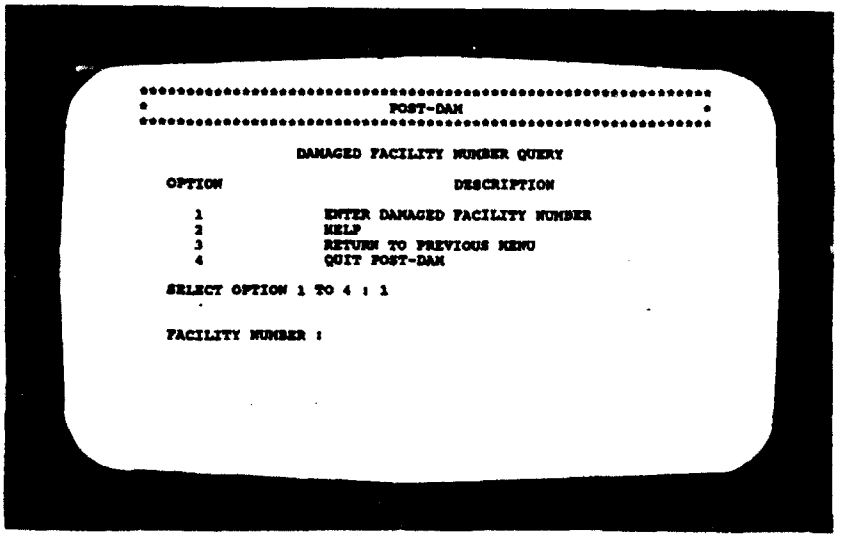


Figure 3.8. POST-DAM Expert System Damaged Facility Number Query Menu with Facility Number Input Prompt.

WARNING! Selecting the number of an already assessed facility will cause the loss of the first assessment's data. The user should reenter a facility number only if that facility needs to be reassessed.

3.3.2.1.4 Damaged Facility Number Help Menu

Selecting Option 2 from the Damaged Facility Number Query menu, shown in Figure 3.7, activates the PDES Help Utility. If the user has disabled the Help Utility (reference Section 3.3.2.1.2), the PDES Help Utility will generate the PDES system message

HELP UTILITY DISABLED. PRESS <Enter> TO CONTINUE:.

Upon pressing the [Enter] key, the user is returned to the menu shown in Figure 3.7. If the user has not disabled the Help Utility (Help Utility in system default mode), the POST-DAM Help Utility: Bitburg Air Base Mission Critical Facilities menu shown in Figure 3.9 is displayed. From this menu, the user is instructed to select one of the valid mission-critical facility numbers listed. Entering a valid mission-critical facility number displays the Assessment of Damaged Facility menu discussed in Section 3.3.2.2.1. Entering an invalid mission-critical facility number generates an error message, and returns the user to the menu shown in Figure 3.7.

WARNING! Selecting the number of an already assessed facility will cause the loss of the first assessment's data. The user should reenter a facility number only if that facility needs to be reassessed.

3.3.2.1.5 Terminating the POST-DAM Expert System

The POST-DAM Expert System can be terminated normally only from its Environmental Level. The two locations from which normal session termination can be accomplished are Option 2 of the Main Menu (shown in Figure 3.4), and Option 4 of the Damaged Facility Number Query menu (shown in Figure 3.7). Selecting either option closes any opened PDES data files, and terminates the compiled version of the program PD.CLP. Exiting the compiled version of PD.CLP returns execution control to the PDES batch job PD.BAT. PD.BAT handles necessary PDES file management, and returns control back to the DOS operating system. The "PDES Logoff Banner," shown in Figure 3.10, is displayed following a normal PDES session termination.

If the POST-DAM Expert System is exited abnormally (either by a system error or by the user initiating the abnormal end of PD.CLP by hitting the [CTRL] C keys), some or all of the PDES data files may be lost. General rules of thumb to remember if PD.CLP experiences an abnormal end (ABEND) are as follows:

* If the ABEND occurs while in the Environmental Level, all PDES data files for previously assessed facilities and/or elements will have been successfully transmitted to the host computer.

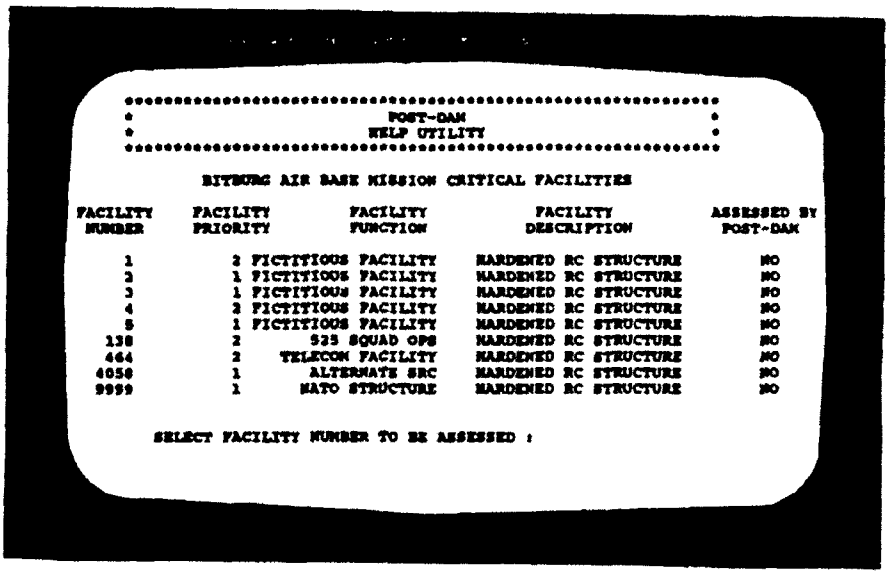


Figure 3.9. POST-DAM Expert System Help Utility: Bitburg AB Mission-Critical Facilities Menu.

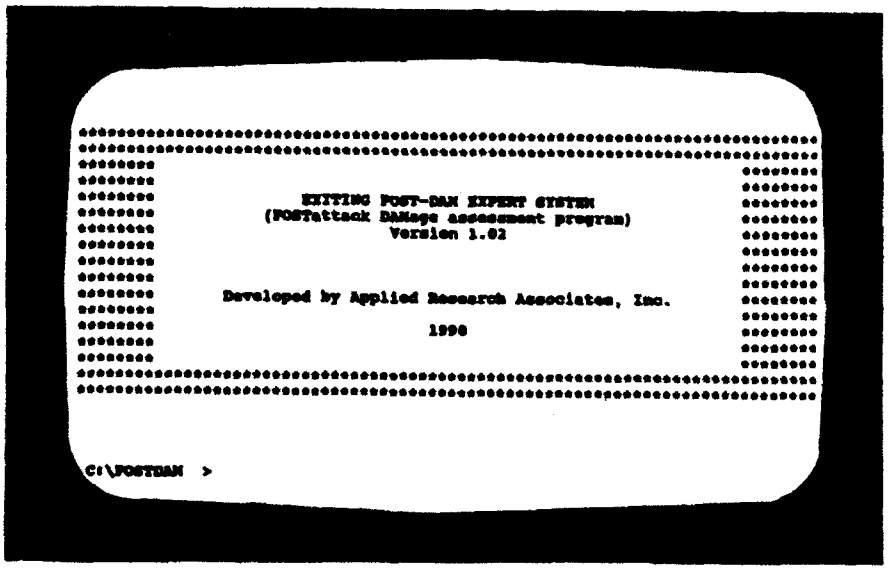


Figure 3.10. POST-DAM Expert System Logoff Banner.

* If the 'BEND occurs in the Facility or the Element Specific Levels, all PDES data files for the current facility will be lost. All PDES data files for previously assessed facilities will have been successfully transmitted to the host computer.

3.3.2.2 Facility Specific Level

The Facility Specific Level is the second level the user enters within a PDES session. Within this level, the PDES system notes the facility number the user has chosen in the Environmental Level (reference Section 3.3.2.1.3), and loads the corresponding facility specific data file into the PDES dynamic knowledge base (reference Figure 1.2). All mission-critical facility-specific data files, for a particular airbase, reside within PDES memory.

Identifying damaged element types, as well as the overall assessment of a mission-critical facility, occur within the PDES Facility Specific Level. Sections 3.3.2.2.1 and 3.3.2.2.2 discuss the general overall assessment of a mission-critical facility, and selecting a damaged element category, respectively.

3.3.2.2.1 Facility Damage Assessment

Entering a valid mission-critical facility number from either the Damaged Facility Number Query Menu (shown in Figure 3.7) or the POST-DAM Help Utility: Airbase Mission-Critical Facilities Menu (shown in Figure 3.9) displays the Assessment of Damaged Facility Menu. This menu, shown in Figure 3.11, is used to tell PDES whether the facility under assessment is a candidate for expedient repair. From this menu the user may enter Options 1 through 4. Each option is discussed below.

OPTION 1

If the facility under assessment is a candidate for expedient repair, select Option 1. Selecting Option 1 displays the Select Damaged Element Category Menu discussed in Section 3.3.2.2.2.

OPTION 2

If the facility under assessment is beyond expedient repair, select Option 2. Entering Option 2 causes the PDES system to write to the .OUT PDES data file a message indicating the facility is beyond expedient repair. No information is written to the .EQP or .MAT data files. PDES then closes all three data files, and the communications software transfers them to the host computer (see Reference 2.2.7). Upon completion of the data transfer, control is again returned to the expert system, and the Damaged Facility Number Query Menu (shown in Figure 3.7) is again displayed, so assessment of another mission-critical facility can begin.

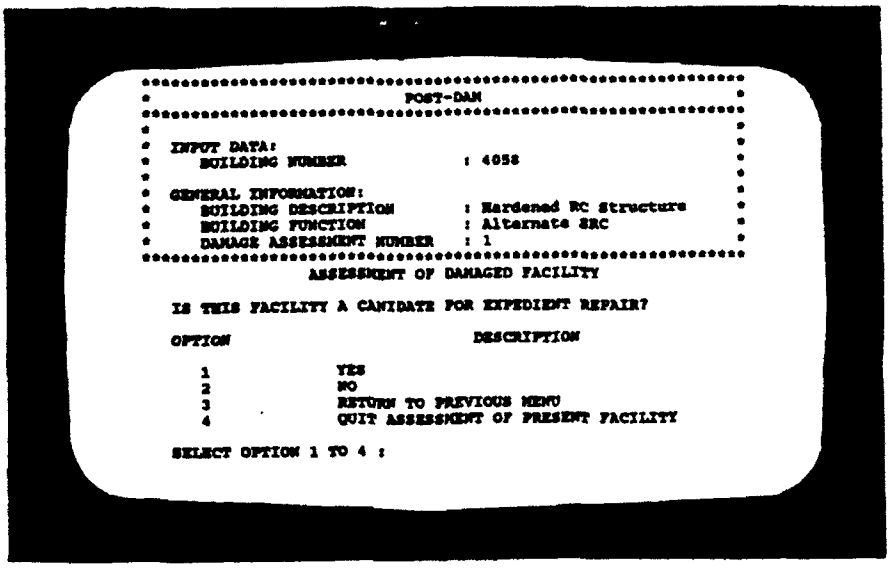


Figure 3.11. POST-DAM Expert System Assessment of Damaged Facility Menu.

OPTION 3

If the user decides the menu shown in Figure 3.11 has been arrived at in error, select Option 3. Selecting Option 3 returns the user to the PDES Damaged Facility Number Query Menu shown in Figure 3.7. The PDES .OUT, .EQP, and .MAT data files are closed, but not transmitted to the POST-DAM host computer. The reader should consult Section 3.3.2.4, entitled "Returning to a Previous PDES Menu," for a complete explanation of this option.

OPTION 4

If the user wishes to terminate assessment of the current facility, select Option 4. Selecting Option 4 closes the PDES .OUT, .EQP, and .MAT data files. If at least one damaged element of the current facility has been assessed prior to termination, the communication software sends the three PDES data files to the POST-DAM host computer. Upon completion of the data transfer, control is again returned to the expert system, and the Damaged Facility Number Query Menu (shown in Figure 3.7) is again displayed, so assessment of another mission-critical facility can begin.

3.3.2.2.2 Selecting a Damaged Element Category

Selecting Option 1 from the Assessment of Damaged Facility Menu (shown in Figure 3.11) displays the Select Damaged Element Category Menu shown in Figure 3.12. This menu is used to tell PDES the type of damaged element to be assessed. From this menu, the user may either choose one of eight element categories, return to the previous menu, or terminate the current facility assessment. Each of the ten options available within this menu is discussed below.

OPTION 1

If the damaged element to be assessed is an exterior wall, select Option 1. Selecting Option 1 displays the Damaged Element Number Query Menu discussed in Section 3.3.2.3.1.

OPTIONS 1 THROUGH 8

Options 1 through 8 are used to tell PDES the element category of the damaged element (within the current mission-critical facility) to be assessed. The PDES element categories are as follows:

OPTION 1	EXTERIOR WALL
OPTION 2	INTERIOR WALL
OPTION 3	ROOF
OPTION 4	FLOOR
OPTION 5	BEAM
OPTION 6	COLUMN
OPTION 7	DOOR
OPTION 8	MISCELLANEOUS

Entering any of these eight options displays the Damaged Element Number Query Menu discussed in Section 3.3.2.3.1.

OPTION 9

If the user wishes to return to the previous menu, instead of selecting a damaged element category, select Option 9. Selecting Option 9 returns the user to the Assessment of Damaged Facility Menu shown in Figure 3.11. The reader should consult Section 3.3.2.4, entitled "Returning to a Previous PDES Menu," for a complete explanation of this option.

OPTION 10

If the user wishes to terminate assessment of the current facility, select Option 10. Selecting Option 10 closes the PDES .OUT, .EQP, and .MAT data files. If at least one damaged element of the current facility has been assessed prior to termination, the communications software sends the three PDES data files to the POST-DAM host computer. Upon completion of the data transfer, control is again returned to the expert system, and the Damaged Facility Number Query Menu (shown in Figure 3.7) is again displayed, so assessment of another mission-critical facility can begin.

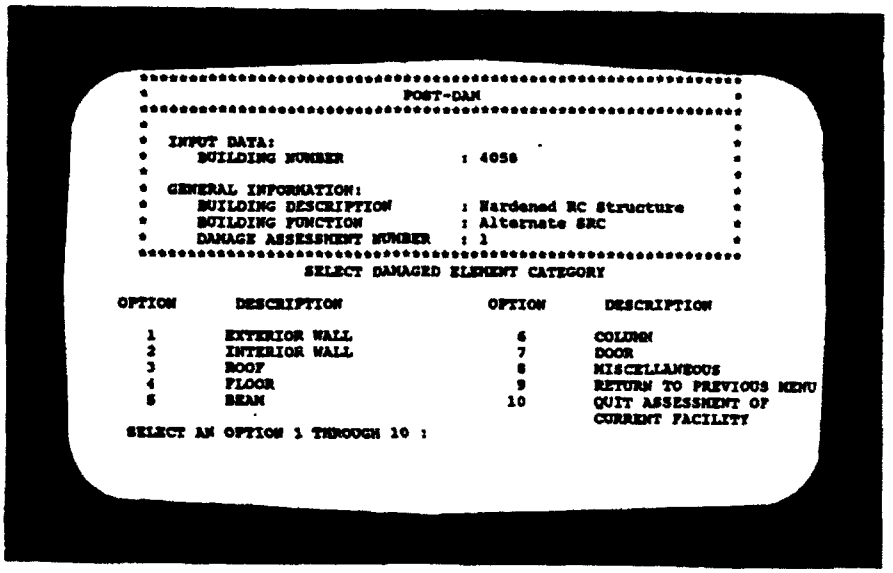


Figure 3.12. POST-DAM Expert System Select Damage Element Category Menu.

3.3.2.3 Element Specific Level

The Element Specific Level is the third level the user enters within a PDES session. Within this level, the PDES system prompts the user for the number of the damaged element, the element's damage mode, and dimensions describing the extent of damage. From this information PDES can assign an expedient repair strategy for the damaged element, and calculate all required repair resources. The following sections describe the various types of PDES menus encountered within the PDES Element Specific Level.

3.3.2.3.1 Entering Damaged Element Number

To assess damage to a mission-critical structural element within a valid mission-critical facility the user must tell PDES the element number. This information is provided to PDES through the Damaged Element Number Query Menu shown in Figure 3.13. PDES checks the element number for validity, against the facility specific data base (imported as described in Section 3.3.2.1.3), and verifies the defined element's category (reference the Select Damaged Element Category Menu discussed in Section 3.3.2.2.2). From the Damaged Element Number Query Menu the user may enter Option 1 through 4. Each option is discussed below.

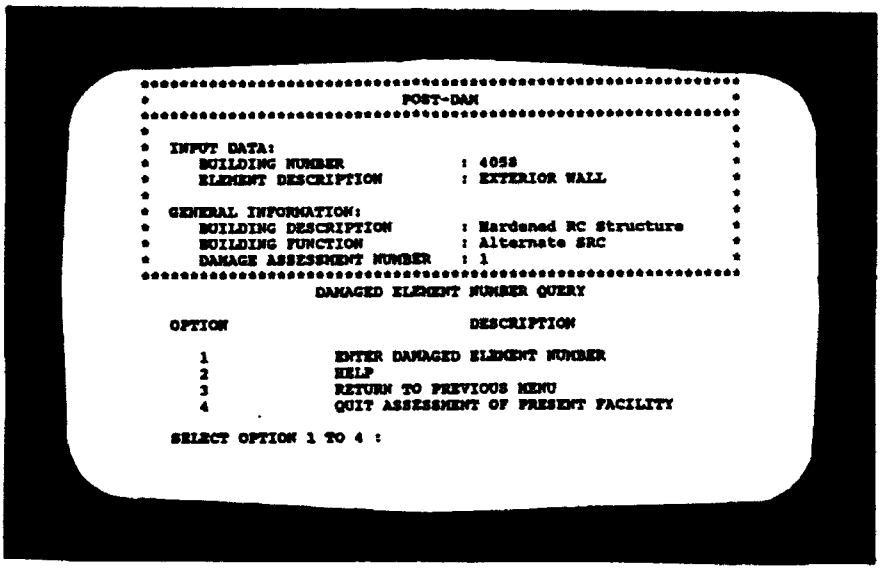


Figure 3.13. POST-DAM Expert System Damaged Element Number Query Menu.

OPTION 1

If the user knows the number of the element to be assessed, select Option 1. Upon selecting Option 1, the user is prompted to enter the element number, as shown in Figure 3.14. Entering a valid mission-critical element number displays one of eight Damage Mode Assessment Menus. The type of damage mode assessment menu displayed depends on the category of the element being assessed. Section 3.3.2.3.2 discusses the various Damage Mode Assessment Menus.

OPTION 2

If the user needs a list of valid mission-critical elements (and the HELP utility is enabled), select Option 2. Selecting Option 2 displays a list of valid element numbers at the bottom of the Damaged Element Number Query Menu, as shown in Figure 3.15. The user is prompted to enter one of the displayed element numbers. Entering a valid mission-critical element number displays one of eight Damage Mode Assessment Menus. The type of damage mode assessment menu displayed depends on the category of the element being assessed. Section 3.3.2.3.2 discusses the various Damage Mode Assessment Menus.

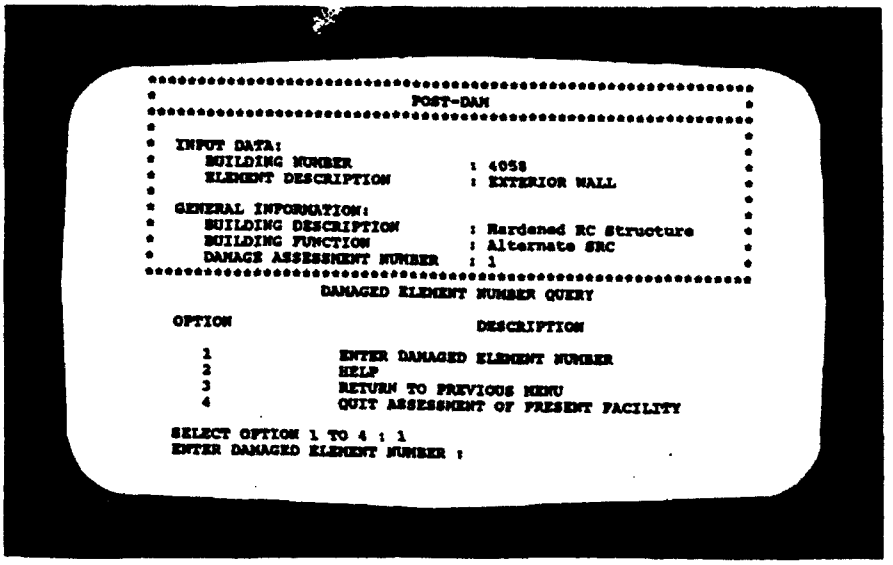


Figure 3.14. POST-DAM Expert System Damaged Element Number Query Menu with Element Number Input Prompt.

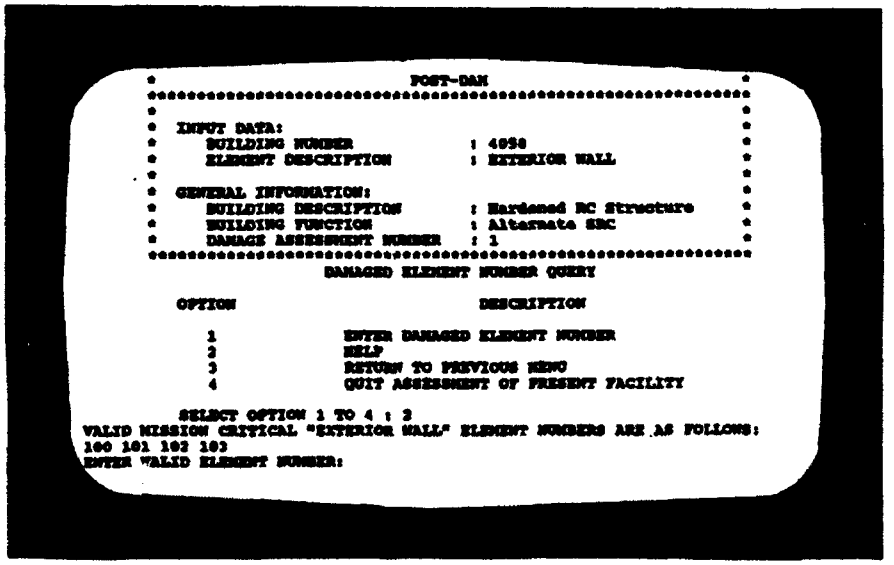


Figure 3.15. POST-DAM Expert System Damaged Element Number Query Menu with Help Option.

OPTION 3

If the user wishes to return to the previous menu, instead of selecting a damaged element number, select Option 3. Selecting Option 3 returns the user to the Select Damaged Element Category Menu shown in Figure 3.12. The reader should consult Section 3.3.2.4, entitled "Returning to a Previous PDES Menu," for a complete explanation of this option.

OPTION 4

If the user wishes to terminate assessment of the current facility, select Option 4. Selecting Option 4 closes the PDES .OUT, .EQP, and .MAT data files. If at least one damaged element of the current facility has been assessed prior to termination, the communications software sends the three PDES data files to the POST-DAM host computer. Upon completion of the data transfer, control is again returned to the expert system, and the Damaged Facility Number Query Menu (shown in Figure 3.7) is again displayed, so assessment of another mission-critical facility can begin.

3.3.2.3.2 Selecting Damage Mode Type

The PDES system has a different Damage Mode Assessment Menu, or menu system, for each of the eight different PDES damaged element categories. These Damage Mode Assessment Menus are shown in Figures 3.16 through 3.23. Notice that in each menu system the user is given a number of options to describe the damage mode of the element being assessed. Selecting the option which best describes the damage mode guides the user to the Enter Damage Specific Dimensions Menu discussed in Section 3.3.2.3.3.

In each menu shown in Figures 3.16 through 3.23, the user is given the option of describing the damage mode as OTHER, or selecting Return to Previous Menu, as well as the option Quit Assessment of Current Element. These options are discussed in detail below.

OPTION: OTHER

This option, within the Damage Mode Assessment Menus, allows the user to define a damage mode other than those already listed in PDES. Upon selecting the OTHER option, the user is taken directly to the Input Verification screen discussed in Section 3.3.2.3.4. At this screen the user should describe the damage mode as clearly as possible at the Applicable Remarks prompt. These remarks will place the PDES-generated expedient repair description "Undetermined" in the facility's .OUT file. PDES does not write to the .EQP or the .MAT files when a repair strategy of "Undetermined" is generated. The host computer operator will then have to assess the damage, based on PDES user remarks, and recommend an expedient repair strategy and required resources, using the POST-DAM System running on the host computer (Reference 2.2.3).

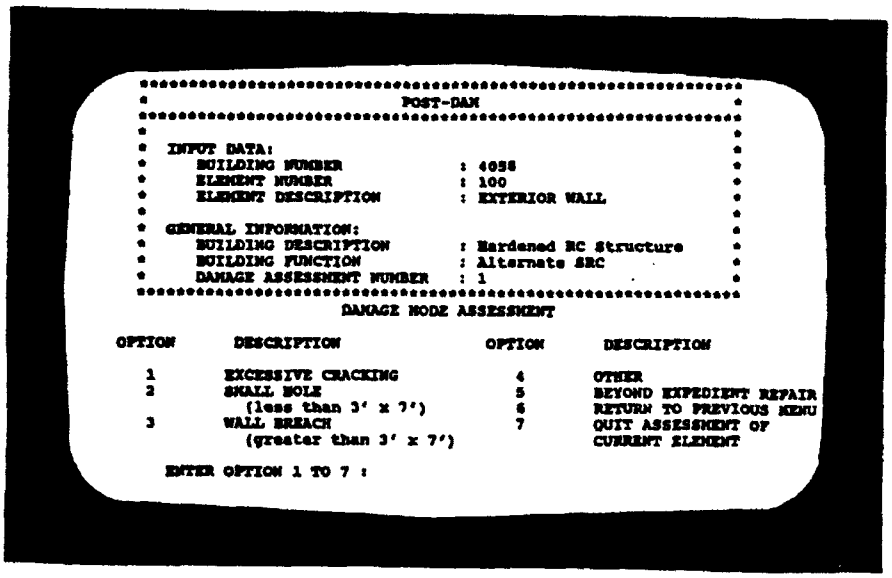


Figure 3.16. POST-DAM Expert System Exterior Wall Damage Mode Assessment Menu.

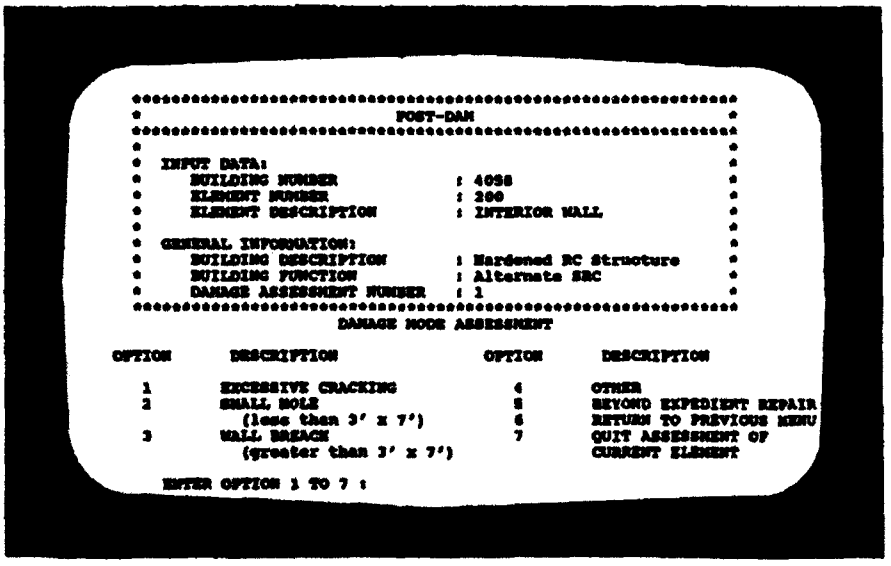


Figure 3.17. POST-DAM Expert System Interior Wall Damage Mode Assessment Menu.

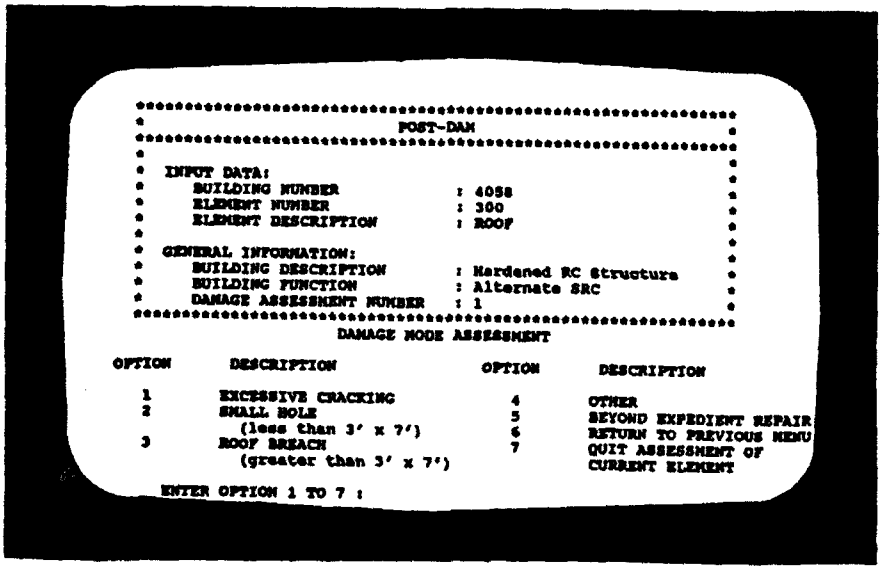


Figure 3.18. POST-DAM Expert System Roof Damage Mode Assessment Menu.

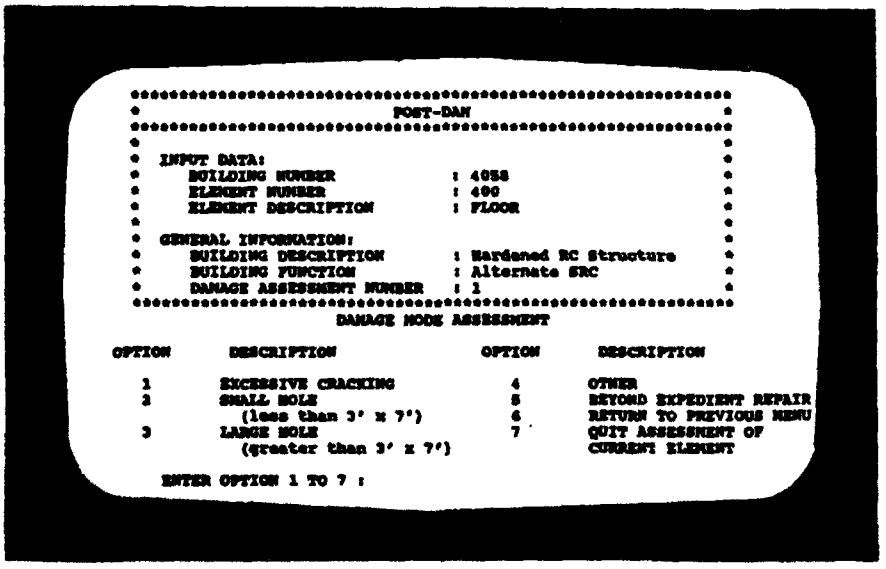


Figure 3.19. POST-DAM Expert System Floor Damage Mode Assessment Menu.

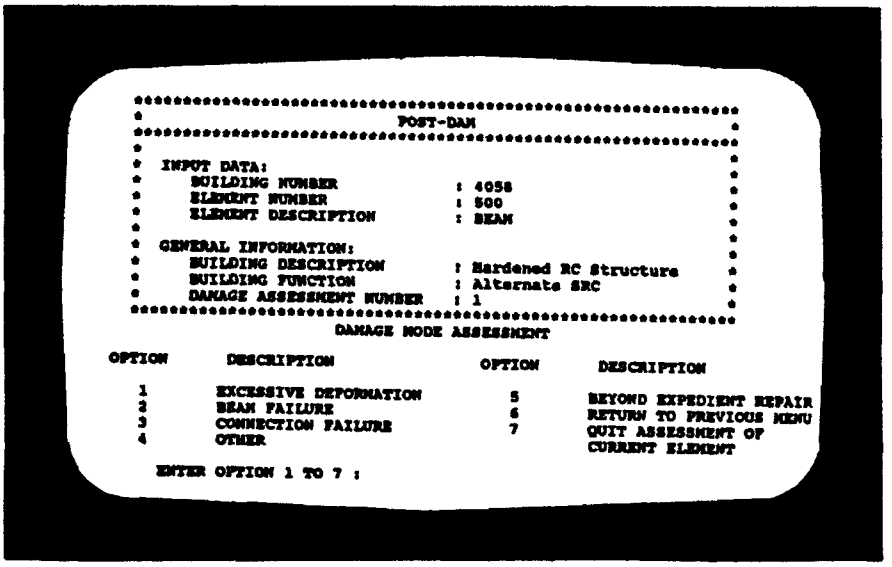


Figure 3.20. POST-DAM Expert System Beam Damage Mode Assessment Menu.

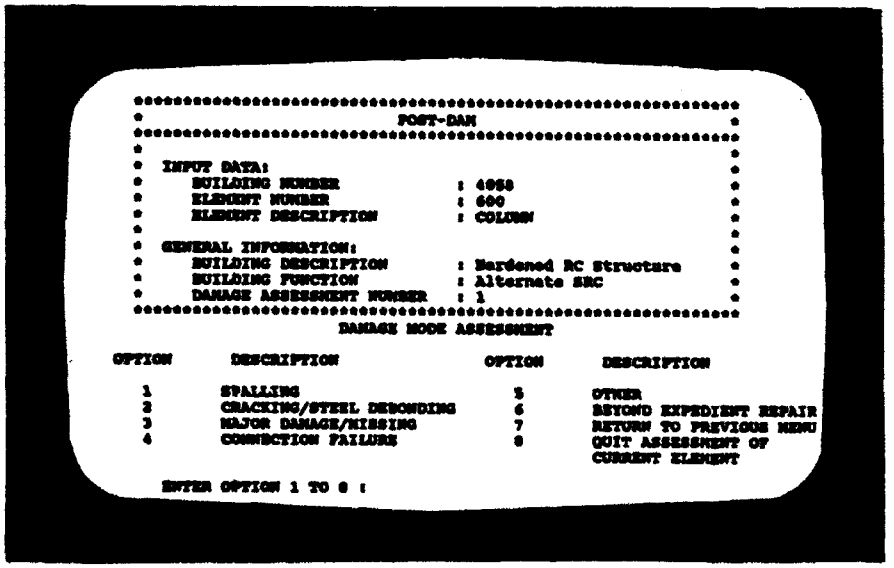


Figure 3.21. POST-DAM Expert System Column Damage Mode Assessment Menu.

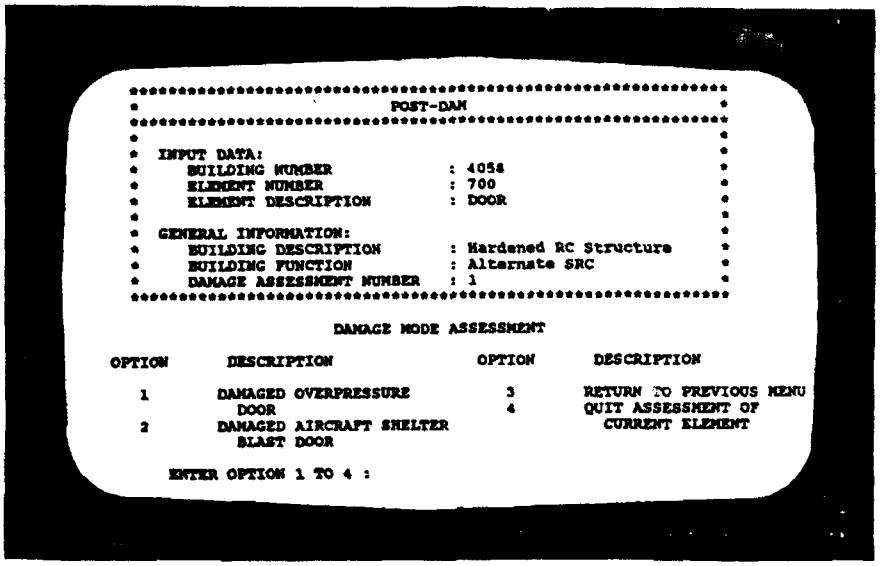


Figure 3.22. POST-DAM Expert System Door Damage Mode Assessment Menu.

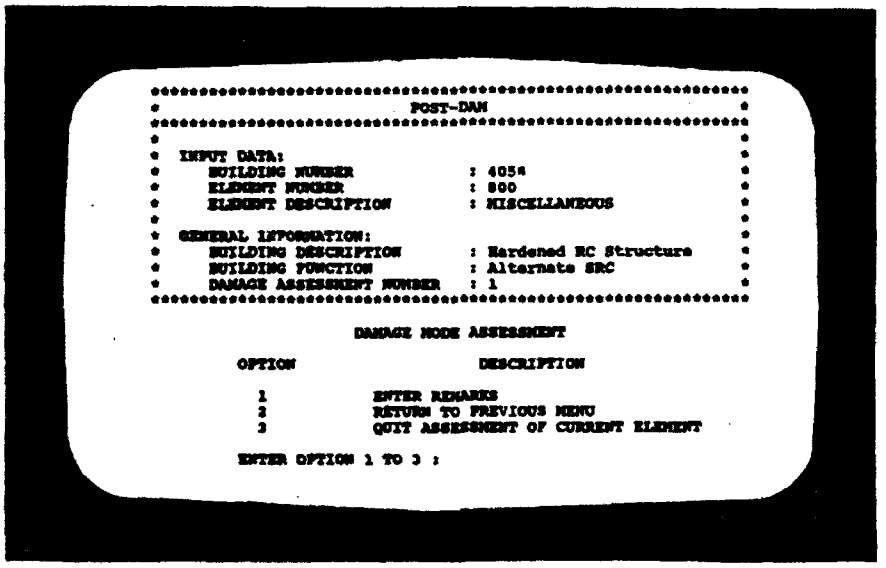


Figure 3.23. POST-DAM Expert System Miscellaneous Damage Mode Assessment Menu.

OPTION: BEYOND EXPEDIENT REPAIR

This option allows the PDES user to report that a particular element, within an otherwise expediently repairable facility, is beyond expedient repair. Selecting the Beyond Expedient Repair option takes the user directly to the Input Verification screen discussed in Section 3.3.2.3.4. PDES then assigns to that element the expedient repair strategy Beyond Expedient Repair, and stores that information in the facility's .OUT file. PDES does not write to the .EQP or the .MAT files when a repair strategy of Beyond Expedient Repair is generated.

OPTION: QUIT ASSESSMENT OF CURRENT ELEMENT

If the user wishes to terminate assessment of the current element, select the Quit Assessment of Current Element option. Selecting this option results in no element-specific data for the current assessment being written to the PDES .OUT, .EQP, or .MAT data files, and returns the user to the Select Damaged Element Category Menu shown in Figure 3.12.

3.3.2.3.3 Entering Damage Specific Dimensions

PDES prompts the user for all necessary damage input for each element being assessed. The type of damage input requested by PDES depends not only on the category of the element being assessed (reference Section 3.3.2.2.2), but also on the damage mode entered for that element (reference Section 3.3.2.3.2). Figure 3.24 shows a typical PDES Damage Input screen for an exterior wall suffering from excessive cracking. The information requested by this menu varies with the element's category and damage mode. After entering all damage data requested by PDES, the system displays the Input Verification Menu discussed in Section 3.3.2.3.4.

3.3.2.3.4 Verifying User Input Data

Once the user has entered all damage input data requested by PDES (reference Section 3.3.2.3.3), the system will have ample information to recommend an expedient repair strategy for the damaged element. Prior to selecting the expedient repair strategy and calculating the required resources, the PDES system allows the user to verify all element-specific data entered for the current assessment. Figure 3.25 shows an Input Verification screen for an exterior wall with excessive cracking.

If the user determines that the element data entered for the current assessment is correct, a response of "yes" is entered at the Is the Input Information Given Above Correct? prompt. The PDES system responds by selecting the most appropriate expedient repair strategy from its knowledge base, and generating all resource requirements. PDES then prompts the user for any applicable remarks, as shown in Figure 3.26. Once the remarks have been entered by the user, PDES displays the Expedient Repair Strategy screen discussed in Section 3.3.2.3.5.

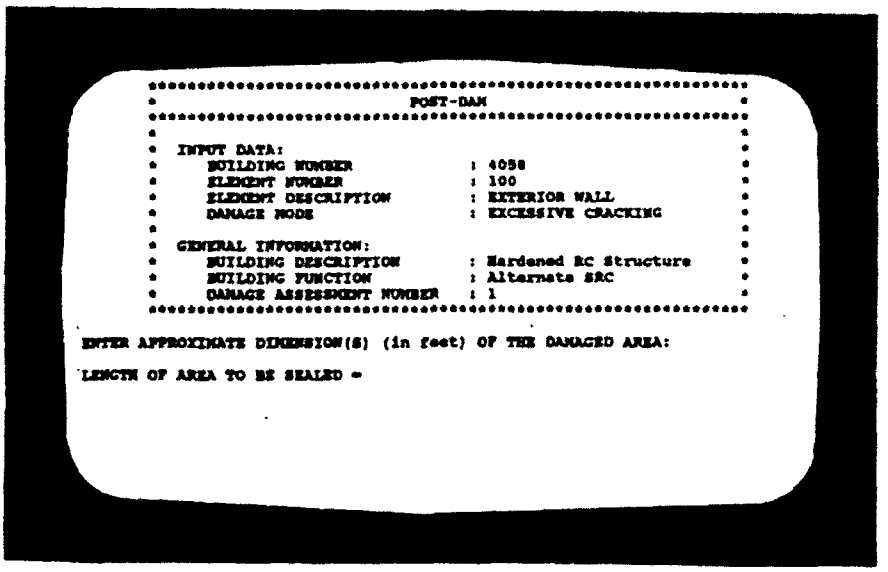


Figure 3.24. POST-DAM Expert System Damage Input Screen.

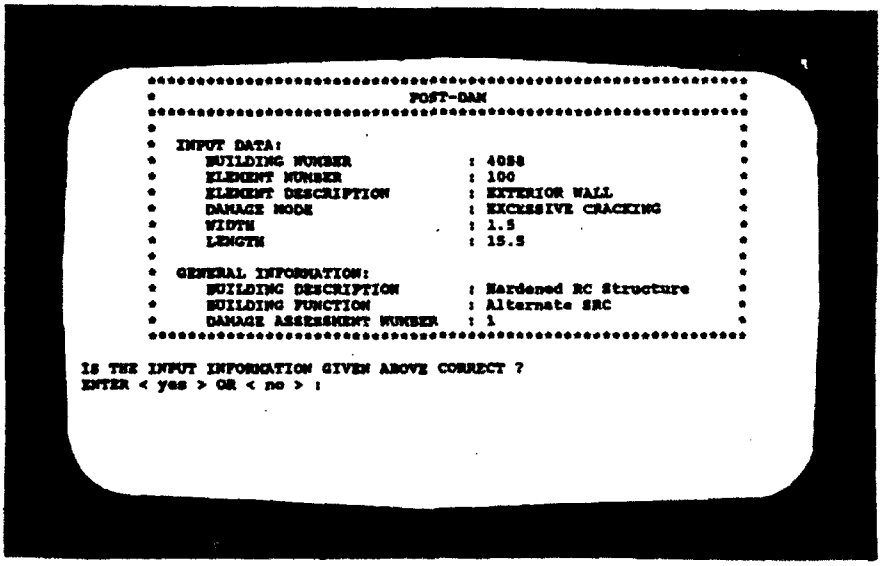


Figure 3.25. POST-DAM Expert System Input Verification Screen.

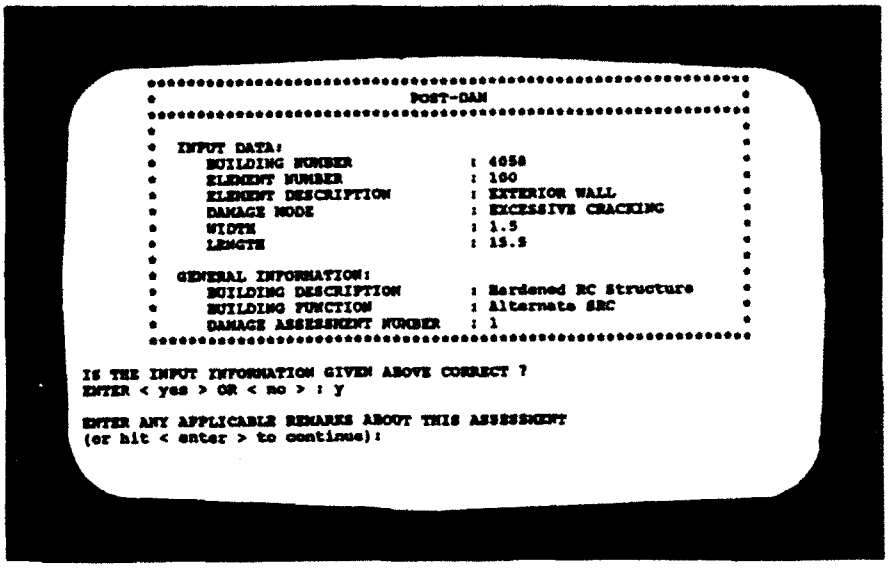


Figure 3.26. POST-DAM Expert System Input Applicable Remarks Screen.

If the user thinks the response to a PDES query was wrong, a response of "no" is entered at the Is the Input Information Given Above Correct ? prompt. A response of "no" returns the user to the Select Damaged Element Category Menu (reference Figure 3.12), without writing data to the PDES .OUT, .EQP, or .MAT data files.

3.3.2.3.5 Reviewing a PDES Expedient Repair Strategy Selection

Once the user exits the Input Verification screens discussed in Section 3.3.2.3.4, PDES searches its knowledge base for the most appropriate expedient repair strategy for the damaged element. The expedient repair strategies and their resource requirements, found within the PDES system, were developed in References 2.1.4 and 2.1.5. Appendix H presents the truth tables that form the correlation between the PDES potential damage modes and their corresponding expedient repairs.

Once an expedient repair strategy is selected, and the resource requirements calculated, PDES writes the information to the PDES .OUT, .EQP, and .MAT data files. However, prior to writing the element information, the system shows the user the recommended expedient repair strategy. An example of the Expedient Repair Strategy screen is shown in Figure 3.27. (NOTE: This screen is not displayed if the Optional Utility Configuration for OUTPUT, reference Section 3.3.2.1.2, has been disabled). After reviewing the selected expedient

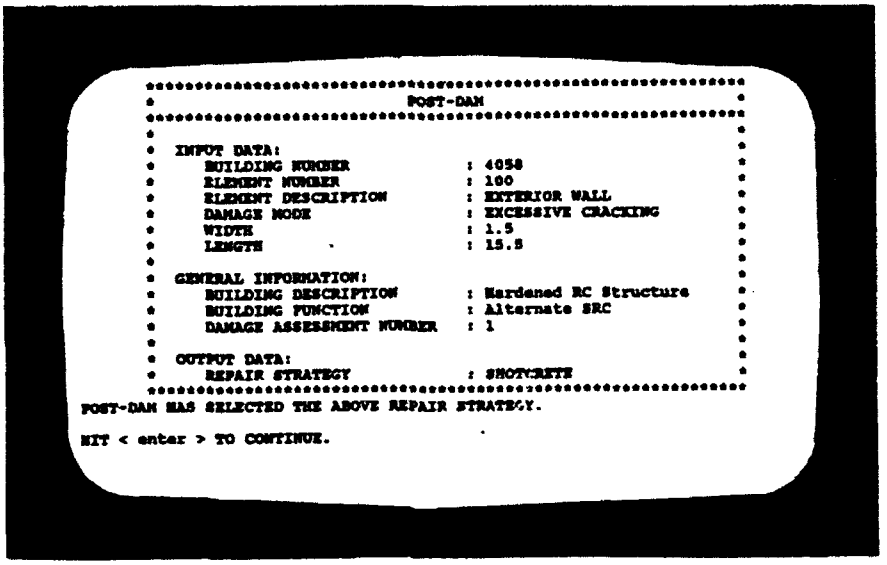


Figure 3.27. POST-DAM Expert System Expedient Repair Strategy Screen.

repair strategy, the user hits the [Enter] key, as instructed. PDES responds by writing the element data to the PDES data files, and returning the user to the Select Damaged Element Category Menu (reference Figure 3.12) to start another element assessment.

3.3.2.4 Returning to a Previous PDES Menu

An option entitled **RETURN TO PREVIOUS MENU** appears in most PDES Menus, to let the user page back one PDES Menu at a time. This option is extremely helpful if the user wishes to modify previously entered input. The PDES Menu system shown in Figure 3.3 shows a typical connectivity between PDES Menus. In this figure, the forward logical flow is indicated with solid arrows. Those menus possessing the **RETURN TO PREVIOUS MENU** option are shown with a dashed arrow pointing to the previous menu.

Extreme care should be exercised when returning to the previous menu. Ascending to the previous menu may have undesirable results when one of the three PDES logical levels (reference Figure 1.3) is crossed. The following discussion on ascending through the PDES logic levels should be understood before using a **RETURN TO PREVIOUS MENU** option.

Ascending From Element-Specific to Facility-Specific Level

Ascending from the Element-Specific Level to the Facility-Specific Level (from the Damaged Element Number Query Menu to the Select Damaged Element Category Menu) results in the loss of all element data for the current assessment.

Ascending From Facility-Specific to Environmental Level

Ascending from the Facility-Specific Level to the Environmental Level (from the Damaged Facility Number Query Menu to the PDES Main Menu and Logon Banner Menu) results in the loss of all facility data for the current and previous assessments.

3.3.3 Transferring PDES Data Files to the Host Computer

PDES can transfer its output data files (See Section 3.4) to the POST-DAM Host Computer either automatically or manually. Automatic file transfer is accomplished when the PDES Utility Configuration communication setting is in the default mode (reference Section 3.3.2.1.2). Otherwise, the data transfer must be accomplished manually. The following two sections discuss the operations and procedures associated with both automatic and manual PDES data transfer.

3.3.3.1 Automatic Data Transfer

To activate the PDES automatic data transfer system, the user must select an option from the POST-DAM Communication System Menu shown in Figure 3.28. The communication menu automatically appears at the conclusion of each facility assessment, if the Optional Utility Configuration communication setting is in its default mode. From the communication menu shown in Figure 3.28, the user can select either of two options for immediate data transfer, or one option to defer data transfer. Each of these options is discussed below.

OPTION 1

Selecting Option 1 immediately transfers the PDES data files to the host computer, then returns the user to the POST-DAM Expert System Main Menu shown in Figure 3.4. The software that handles the data transfer is written in the CROSSTALK Applications Script Language (CASL). This program and the entire communication system are discussed in SUM Volume 8, CROSSTALK Mk.4 for the Remote Computer (Reference 2.2.7).

OPTION 2

Selecting Option 2 immediately transfers the PDES data files to the host computer, then terminates the current PDES session, and returns control to the DOS operating system. The POST-DAM Expert System Logoff Banner, shown in Figure 3.10, is displayed at the end of the data transfer. The software that handles the data transfer is written in the CROSSTALK Applications Script Language (CASL). This program and the entire communication system are discussed in SUM Volume 8, CROSSTALK Mk.4 for the Remote Computer (Reference 2.2.7).

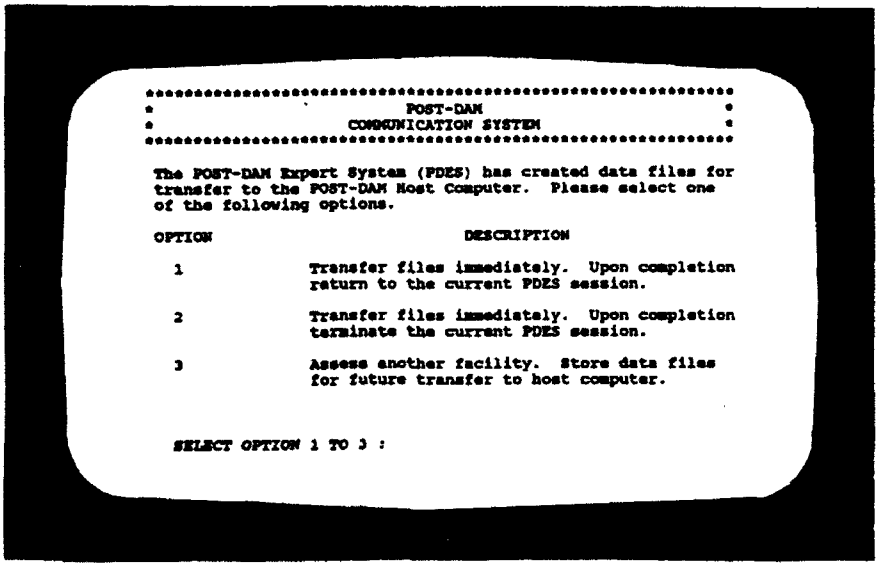


Figure 3.28. POST-DAM Expert System Communication Menu.

OPTION 3

Selecting Option 3 allows the user to assess another facility, while temporarily storing the current PDES data files in the subdirectory C:\POSTDAM\DCC. This option can be repeated at the end of each of as many facility assessments as desired. Eventually selecting Option 1 or 2, or terminating PDES, then transfers all data files temporarily stored in C:\POSTDAM\DCC. Selecting Option 3 returns the user to the POST-DAM Expert System Damaged Facility Number Query Menu, shown in Figure 3.7. From this menu the user can enter the number of another facility to be assessed.

3.3.3.2 Manual Data Transfer

The automatic data transfer feature can be disabled, as discussed in Section 3.3.2.1.2, if the user desires to transfer the PDES data files manually. Enabling manual data transfer eliminates the time required for communication software execution at the end of each facility assessment. If automatic data transfer is disabled, the PDES system will not show the POST-DAM Communication System Menu (reference Figure 3.28) at the end of each facility assessment. To manually transfer the PDES data files to the host computer, the user must follow the steps listed below.

1. Terminate the PDES session, as described in Section 3.3.2.1.5.

2. Enter the following DOS command at the C:\POSTDAM > prompt

C:\POSTDAM > xtalk4\xtalk call dcc

This DOS command causes automatic transfer of all PDES data files from the most current PDES session terminated. The software that handles the data transfer is written in the CROSSTALK Applications Script Language (CASL). This program and the entire communication system are discussed in SUM Volume 8, CROSSTALK Mk.4 for the Remote Computer (Reference 2.2.7).

3.4 PDES OUTPUT

The POST-DAM Expert System generates three types of output files for each mission-critical facility assessed. These output files have the file extensions .OUT, .EQP, and .MAT. The files are named according to the facility being assessed, as shown below:

B(facility number).OUT
B(facility number).EQP
B(facility number).MAT

In the above nomenclature the facility number is substituted for (facility number) (i.e., B4058.OUT for Facility 4058). These PDES output files are transferred to the host computer, as indicated in Section 3.3.3, for further processing by the POST-DAM System. A copy of each output file is also stored in the subdirectory PD_FILE. Sections 3.4.1, 3.4.2, and 3.4.3 discuss each of the PDES output files in further detail.

3.4.1 PDES .OUT Files

The POST-DAM Expert System generates a report for each mission-critical facility assessed during a PDES session. These reports contain information on the facility being assessed, as well as information on each of the facility's damaged elements and its PDES-generated expedient repair strategy. Each report generated during a PDES session is transferred through the PDES .OUT files to the POST-DAM host computer for further processing.

The .OUT files are formatted into sections entitled HEADER, SECTION I, and SECTION II. The HEADER of the .OUT file contains the number of the damaged facility, and the name of the airbase on which the damaged facility is located. This HEADER appears at the top of each page of the report (.OUT file). SECTION I of the .OUT file is used to store general information on the facility being assessed. This file section contains the facility function, its mission-critical priority number, and a general structural description. SECTION II of the .OUT file contains the damage assessment(s) thus far completed, for that mission-critical facility. The information in SECTION II of the .OUT file varies, depending on whether the facility can be expediently repaired. The following discussions detail SECTION II for each case.

Facility Beyond Expedient Repair

If the facility being assessed is beyond expedient repair (reference Section 3.3.2.2.1), a message indicating this fact will appear in Section II of the PDES .OUT file. Figure 3.29 shows an example of a PDES .OUT file in which the user indicated the facility was beyond expedient repair.

Facility a Candidate for Expedient Repair

If the facility being assessed is a candidate for expedient repair (reference Section 3.3.2.2.1), Section II of the .OUT file will be partitioned to accommodate the different assessments. Within each assessment, PDES generates two subheadings entitled "General Element Information" and "Repair Strategy Information." The general element information section contains information on the damaged element and its damage mode. The repair strategy information section contains the PDES-generated expedient repair strategy, the corresponding repair resource requirements, and an entry entitled "Repair Schedule." This section is left blank, to be completed by the POST-DAM System host computer operator (Reference 2.2.4). Figure 3.30 shows a PDES .OUT file containing three element assessments for a damaged, mission-critical facility.

3.4.2 PDES .EQP Files

Once PDES has selected an expedient repair strategy for a damaged element, it calculates the equipment resources required to perform the repair. This equipment information is written in the PDES .EQP file, in delimited ASCII format, for each element damage assessment performed for a given mission-critical facility. This file is transferred, upon completion of the facility assessment, to the POST-DAM System Host Computer for further processing. Figure 3.31 shows a typical PDES .EQP file for a facility for which three element damage assessments have been performed.

3.4.3 PDES .MAT Files

Once PDES has selected an expedient repair strategy for a damaged element, it calculates the material resources required to perform the repair. This material information is written in the PDES .MAT file, in delimited ASCII format, for each element damage assessment performed for a given mission-critical facility. This file is transferred, upon completion of the facility assessment, to the POST-DAM System Host Computer for further processing. Figure 3.32 shows a typical PDES .MAT file for a facility for which three element damage assessments have been performed.

3.5 PDES KNOWLEDGE BASE

The PDES knowledge base has two components. They are the "static" and "dynamic" knowledge bases (reference Figure 1.2). The term "static" means the facts contained in that portion of the knowledge base are constant. Therefore, each time PDES is compiled, the same facts are loaded from the PDES system memory (DAT subdirectory of the C drive). The term "dynamic" means the facts contained in that portion of the knowledge base may change for each PDES session, or

```
                    POST-ATTACK DAMAGE ASSESSMENT OF
                          FACILITY NUMBER    5
                       BITBURG AIR BASE, GERMANY

 I.) GENERAL FACILITY INFORMATION

     Function    :  "FICTITIOUS FACILITY"
     Priority    :  2
     Description :  "HARDENED RC STRUCTURE"

II.) DAMAGE ASSESSMENTS

     Damage to building number 5 places it beyond expedient repair.
     No manpower or equipment will be scheduled.


**********  END OF OUTPUT DATA FOR BUILDING NUMBER    5  **********
```

Figure 3.29. POST-DAM Expert System .OUT File for a Facility Beyond Expedient Repair.

```
                    POST-ATTACK DAMAGE ASSESSMENT OF
                          FACILITY NUMBER 4058
                        BITBURG AIR BASE, GERMANY

 I.) GENERAL FACILITY INFORMATION

     Function    :  "ALTERNATE SRC"
     Priority    :  1
     Description :  "HARDENED RC STRUCTURE"

II.) DAMAGE ASSESSMENTS

     Damage Assessment Number :  1

     A.) General Element Information

         Element Number      :  103
         Element Description :  EXTERIOR WALL
         Damage Mode         :  WALL BREACH
         Damage Width        :  12.5 ft.
         Damage Height       :  8.5  ft.
         Repair Strategy     :  SHOTCRETE

     B.) Repair Strategy Information

         1.) Required Materials :

             Grade A 2x4         :   44.3 ft.
             Grade A Plywood     :  152.3 sq. ft.
             Wire Mesh           :  106.3 sq. ft.
             Shotcrete Material :    4.7 cubic yards
             Water               :  140.2 gallons

         2.) Required Equipment :

             Shotcrete Unit w/ Accessories :  1
             Repair Team(s)                :  1
             Ramset w/ Stud                :  2

         3.) Estimated Repair Time :

             Repair Team Hours :   3.75

         4.) Remarks  :

             ROOM EXPOSED TO OUTSIDE ENVIRONMENT.  SEAL ROOM.

         5.) Repair Schedule  :

             Start Repair  :
             Finish Repair :
```

Figure 3.30. POST-DAM Expert System .OUT File for a Facility which can be Expediently Repaired.

POST-ATTACK DAMAGE ASSESSMENT OF
FACILITY NUMBER 4058
BITBURG AIR BASE, GERMANY
(continue)

Damage Assessment Number : 2

A.) General Element Information

Element Number	:	301
Element Description	:	ROOF
Damage Mode	:	ROOF BREACH
Damage Width	:	4.5 ft.
Damage Height	:	8.0 ft.
Damage Length	:	10.5 ft.
Repair Strategy	:	SHOTCRETE

B.) Repair Strategy Information

1.) Required Materials :

Grade A 2x4	:	43.3 ft.
Grade A Plywood	:	81.3 sq. ft.
Wire Mesh	:	47.3 sq. ft.
Shotcrete Material	:	2.1 cubic yards
Water	:	62.3 gallons

2.) Required Equipment :

Shotcrete Unit w/ Accessories	:	1
Repair Team(s)	:	1
Ramset w/ Stud	:	2

3.) Estimated Repair Time :

Repair Team Hours : 2.25

4.) Remarks :

THIRD FLOOR EXPOSED TO OUTSIDE ENVIRONMENT. SEAL OFF 3RD FLOOR.

5.) Repair Schedule :

Start Repair :
Finish Repair :

Figure 3.30. POST-DAM Expert System .OUT File for a Facility which can be Expediently Repaired (Continued).

```
                    POST-ATTACK DAMAGE ASSESSMENT OF
                          FACILITY NUMBER 4058
                        BITBURG AIR BASE, GERMANY
                              (continue)

Damage Assessment Number :  3

A.) General Element Information

    Element Number      :  603
    Element Description :  COLUMN
    Damage Mode         :  MAJOR DAMAGE / MISSING
    Damage Height       :  10.0 ft.
    Repair Strategy     :  COLUMN SHORE

B.) Repair Strategy Information

    1.) Required Materials :

        Glulam Column       :   10.0 feet

    2.) Required Equipment :

        Ramset w/ Stud              :  2
        Shoring Jack                :  1
        Chain saw                   :  1

    3.) Estimated Repair Time :

        Repair Team Hours :   2.00

    4.) Remarks  :

        NONE.

    5.) Repair Schedule  :

        Start Repair  :
        Finish Repair :

**********  END OF OUTPUT DATA FOR BUILDING NUMBER 4058  **********
```

Figure 3.30. POST-DAM Expert System .OUT File for a Facility which can be Expediently Repaired (Concluded).

```
"1" "shotcrete machine" "1" "ea" "  3.75"
"1" "air compressor" "1" "ea" "  3.75"
"1" "electric generator" "1" "ea" "  3.75"
"1" "water heater / pump" "1" "ea" "  3.75"
"1" "water hose (50 ft.)" "1" "ea" "  3.75"
"1" "water buffalo" "1" "ea" "  3.75"
"1" "ramset w/ stud" "2" "ea" "  3.75"
"1" "repair team" "1" "ea" "  3.75"
"2" "shotcrete machine" "1" "ea" "  2.50"
"2" "air compressor" "1" "ea" "  2.50"
"2" "electric generator" "1" "ea" "  2.50"
"2" "water heater / pump" "1" "ea" "  2.50"
"2" "water hose (50 ft.)" "1" "ea" "  2.50"
"2" "water buffalo" "1" "ea" "  2.50"
"2" "ramset w/ stud" "2" "ea" "  2.50"
"2" "repair team" "1" "ea" "  2.50"
"3" "ramset w/ stud" "2" "ea" "  2.00"
"3" "shoring jack" "1" "ea" "  2.00"
"3" "chainsaw" "1" "ea" "  2.00"
"3" "repair team" "1" "ea" "  2.00"
```

Figure 3.31. POST-DAM Expert System Typical .EQP File.

```
"1" "plywood 4x8 .5in" "5" "ea"
"1" "wire mesh" " 106.3" "sqf"
"1" "shotcrete" "   4.7" "cy"
"1" "water" " 140.2" "gal"
"2" "2x4 16ft" "3" "ea"
"2" "plywood 4x8 .5in" "3" "ea"
"2" "wire mesh" "  36.0" "sqf"
"2" "shotcrete" "   1.6" "cy"
"2" "water" "  47.5" "gal"
"3" "glulam column 12x12 10ft" "1"
                                "ea"
```

Figure 3.32. POST-DAM Expert System Typical .MAT File.

several times within a session. This portion of the knowledge base contains facility-dependent facts. These facts are loaded into the knowledge base from facility-specific data files stored in the PDES system memory. Dynamic memory allows PDES to load and unload facts pertaining to the facility being assessed. This capability saves valuable RAM, and enables PDES to operate faster. Sections 3.5.1 and 3.5.2 discuss specific aspects of both PDES's static and dynamic knowledge bases.

3.5.1 Static Knowledge Base

PDES is a phase-controlled expert system, which needs "control" facts to fire the system's rules in a regulated manner. The static facts of the PDES knowledge base are the control facts used to assure proper execution of the expert system. Figure 3.33 shows the facts comprising the PDES static knowledge base, in their initial state.

3.5.2 Dynamic Knowledge Base

The PDES dynamic knowledge base contains only airbase- and facility-specific knowledge. The system operates by loading into its knowledge base the airbase-specific data in the PDES system memory (reference Figure 1.2). The airbase-specific data indicate the airbase on which assessments are to be performed, and the mission-critical facilities located on that airbase. The expert system then asks the user to input a mission-critical facility to be assessed (reference Section 3.3.2.1.3). If a valid mission-critical facility is entered, PDES will load the data for that facility from the PDES system memory into its knowledge base. Figure 3.34 shows a typical PDES dynamic knowledge base with airbase- and facility-specific knowledge loaded.

3.5.2.1 Current Mission-Critical Facility Data Files

The data presently in the PDES system memory are for prototype testing only. Although it includes a variety of facility-specific data files, it is assumed for testing purposes that all these facilities are located on Bitburg Air Base, Germany. Therefore, the airbase-specific data for this test version of PDES is labelled "BITBURG.DAT."

The facility-specific data files in the system memory include the files entitled:

BLDG138.DAT	BLDG464.DAT	BLDG4058.DAT	BLDG9999.DAT
BLDG1.DAT	BLDG2.DAT	BLDG3.DAT	BLDG4.DAT
BLDG5.DAT			

These files were obtained from a variety of sources. The files named BLDG138.DAT, BLDG464.DAT, and BLDG4058.DAT were constructed from data obtained by performing a hypothetical damage assessment of mission-critical facilities 138, 464, and 4058 at Bitburg Air Base, Germany (Reference 2.2.8). The file named BLDG9999.DAT was constructed by performing a hypothetical damage assessment of the NATO Structure at Tyndall Air Force Base, Florida (Reference 2.2.8). The remaining five files are for fictitious structures, which augment the range of facilities and element types for system testing purposes.

```
(banner logon)
(building-header 0 0 "null" "null")
(element-header 0 "null" "null" "null")
(assessment-number 1)
(data 0 0 0)
(setup help-on input-on output-on printer-off comm-off)
(carrage-return 22)
(0 facility-header 0 0 "null" "null" DUMMYCARD)
```

Figure 3.33. POST-DAM Expert System Static Knowledge Base.

```
(building-header 4058 2 "HARDENED RC STRUCTURE" "ALTERNATE SRC")
(MISSION-CRITICAL-EXTERIOR-WALLS 100 101 102 103)
(MISSION-CRITICAL-INTERIOR-WALLS 200 201 202)
(MISSION-CRITICAL-ROOFS 300 301 302)
(MISSION-CRITICAL-FLOORS 400 401)
(MISSION-CRITICAL-BEAMS 500 501 502 503)
(MISSION-CRITICAL-COLUMNS 600 601 602 603 604)
(MISSION-CRITICAL-DOORS 700 701)
(MISSION-CRITICAL-MISCELLANEOUS 800)
(EXTERIOR-WALL 100 masonry 0 9.5 0 0 nlc)
(EXTERIOR-WALL 101 masonry 0 9.5 0 0 nlc)
(EXTERIOR-WALL 102 masonry 1 9.5 0 0 nlc)
(EXTERIOR-WALL 103 masonry 2 9.5 0 0 nlc)
(INTERIOR-WALL 200 masonry 0 9.5 0 0 nlc)
(INTERIOR-WALL 201 masonry 0 9.5 0 0 nlc)
(INTERIOR-WALL 202 masonry 0 9.5 0 0 nlc)
(ROOF 300 concrete 2 9.5 0 0 null)
(ROOF 301 concrete 2 9.5 0 0 null)
(ROOF 302 concrete 2 9.5 0 0 null)
(FLOOR 400 concrete 0 4.0 0 0 null)
(FLOOR 401 concrete 1 4.0 0 0 null)
(BEAM 500 concrete 1 9.5 9.5 120 100)
(BEAM 501 concrete 1 9.5 9.5 120 100)
(BEAM 502 concrete 2 9.5 9.5 120 100)
(BEAM 503 concrete 2 9.5 9.5 120 100)
(COLUMN 600 concrete 1 9.5 9.5 120 100)
(COLUMN 601 concrete 1 9.5 9.5 120 100)
(COLUMN 602 concrete 1 9.5 9.5 120 500)
(COLUMN 603 concrete 1 9.5 9.5 120 500)
(COLUMN 604 concrete 1 9.5 9.5 120 500)
(DOOR 700 STEEL 0 6.0 48.0 96.0 PERSONEL-BLAST-DOOR)
(DOOR 701 STEEL 0 6.0 48.0 96.0 OVERPRESSURE-DOOR)
(MISCELLANEOUS 800 STEEL 0 0 0 0 VENT)
```

Figure 3.34. POST-DAM Expert System Typical Dynamic Knowledge Base.

3.5.2.2 Format of Imported Mission-Critical Facility Files

The airbase- and facility-specific data must be entered into their respective files in a particular format, so PDES will interpret the data correctly. The following two sections detail the formats for each type of data entry.

3.5.2.2.1 Airbase-Specific Data File

Within the AIRBASE-SPECIFIC DATA FILE are three data types, or blocks. Figure 3.35 shows the AIRBASE-SPECIFIC DATA FILE generated for the PDES prototype test, and included on the PDES System Diskette. The data blocks and their format are as follows:

BLOCK 1: AIRBASE ID

The first data block in the AIRBASE-SPECIFIC DATA FILE is the AIRBASE ID. This block tells PDES the airbase on which the assessments will occur. The format for this data entry is as follows:

(<AIRBASE ID> number-of-mission-critical-facilities <NUMBER>)

where,

<AIRBASE ID>: The airbase identification (i.e., BITBURG-AB)

<NUMBER>: The number of mission-critical facilities on the specified airbase.

BLOCK 2: FACILITY ID

The second data block in the AIRBASE-SPECIFIC DATA FILE is the FACILITY ID. This block identifies the mission-critical facilities on the specified airbase. The format for the FACILITY ID block is as follows:

(mission-critical-facilities <FACILITY NUMBERS>)

where,

<FACILITY NUMBERS>: List of mission-critical facilities.

BLOCK 3: FACILITY HEADER

The third data block in the AIRBASE-SPECIFIC DATA FILE is the FACILITY HEADER. This block contains general information about each facility listed in the FACILITY ID block. Therefore, there should be the same number of data entries in this block as there are in the <FACILITY NUMBERS> field of the FACILITY ID block. The format for the FACILITY HEADER is as follows:

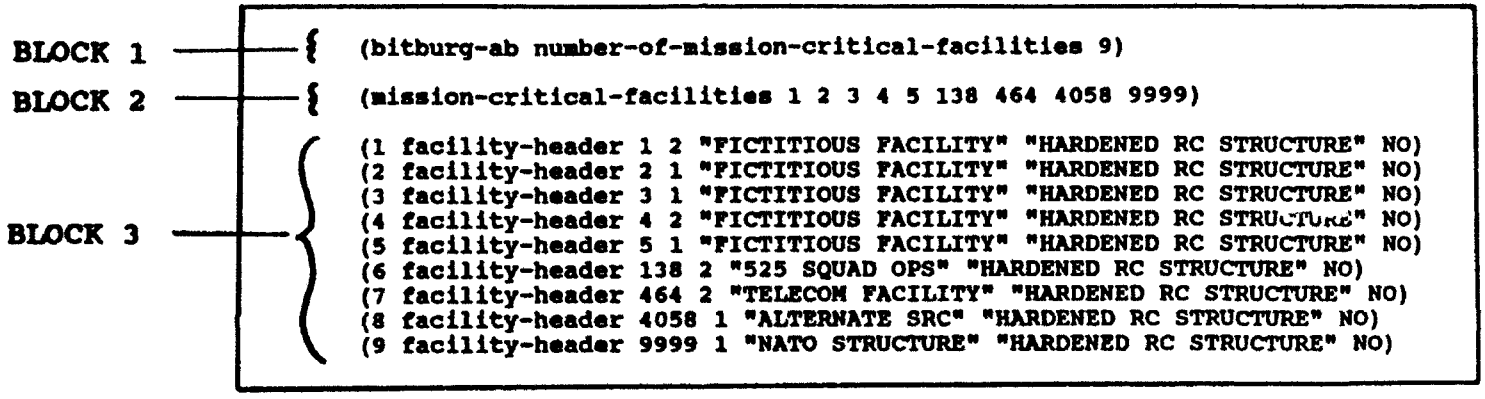


Figure 3.35. POST-DAM Expert System Typical Airbase-Specific Data File.

(<HEADER CARD> **facility-header** <FACILITY NUMBER> <PRIORITY>
<FUNCTION> <DESCRIPTION> <ASSESSMENT STATUS>)

where,

<HEADER CARD>:	Is a sequential numbering field for the FACILITY HEADER block. The first FACILITY HEADER entry is the Number 1. Each successive FACILITY HEADER entry is incremented by 1. The final FACILITY HEADER entry should be the same value entered in the <NUMBER> field of the AIRBASE ID block. The FACILITY HEADER entries must correspond to the <FACILITY NUMBERS> listed in the FACILITY ID block.
<FACILITY NUMBER>:	The facility number of the mission-critical facility.
<PRIORITY>:	The priority assigned to the mission-critical facility by the Base Civil Engineer (BCE).
<FUNCTION>:	The function of the mission-critical facility.
<DESCRIPTION>:	A general description of the facility's construction.
<STATUS>:	The current assessment status of the facility. Always initialized to "NO".

3.5.2.2.2 Facility Specific Data Files

Within the FACILITY-SPECIFIC DATA FILE are three data types, or blocks. Figure 3.36 shows the FACILITY-SPECIFIC DATA FILE generated for Bitburg Facility 4058. This FACILITY-SPECIFIC DATA FILE was developed for the PDES prototype test, and is included on the PDES System Diskette. The three data blocks in the FACILITY-SPECIFIC DATA FILE, and their format are as follows:

BLOCK 1: BUILDING HEADER

The first data block is the BUILDING HEADER block. This block identifies the mission-critical facility by number, and contains general facility information. The format for this data block is as follows:

(**building-header** <FACILITY NUMBER> <PRIORITY> <DESCRIPTION> <FUNCTION>)

where,

<FACILITY NUMBER>:	The facility number of the mission-critical facility.
<PRIORITY>:	The priority assigned to the mission-critical facility by the BCE.

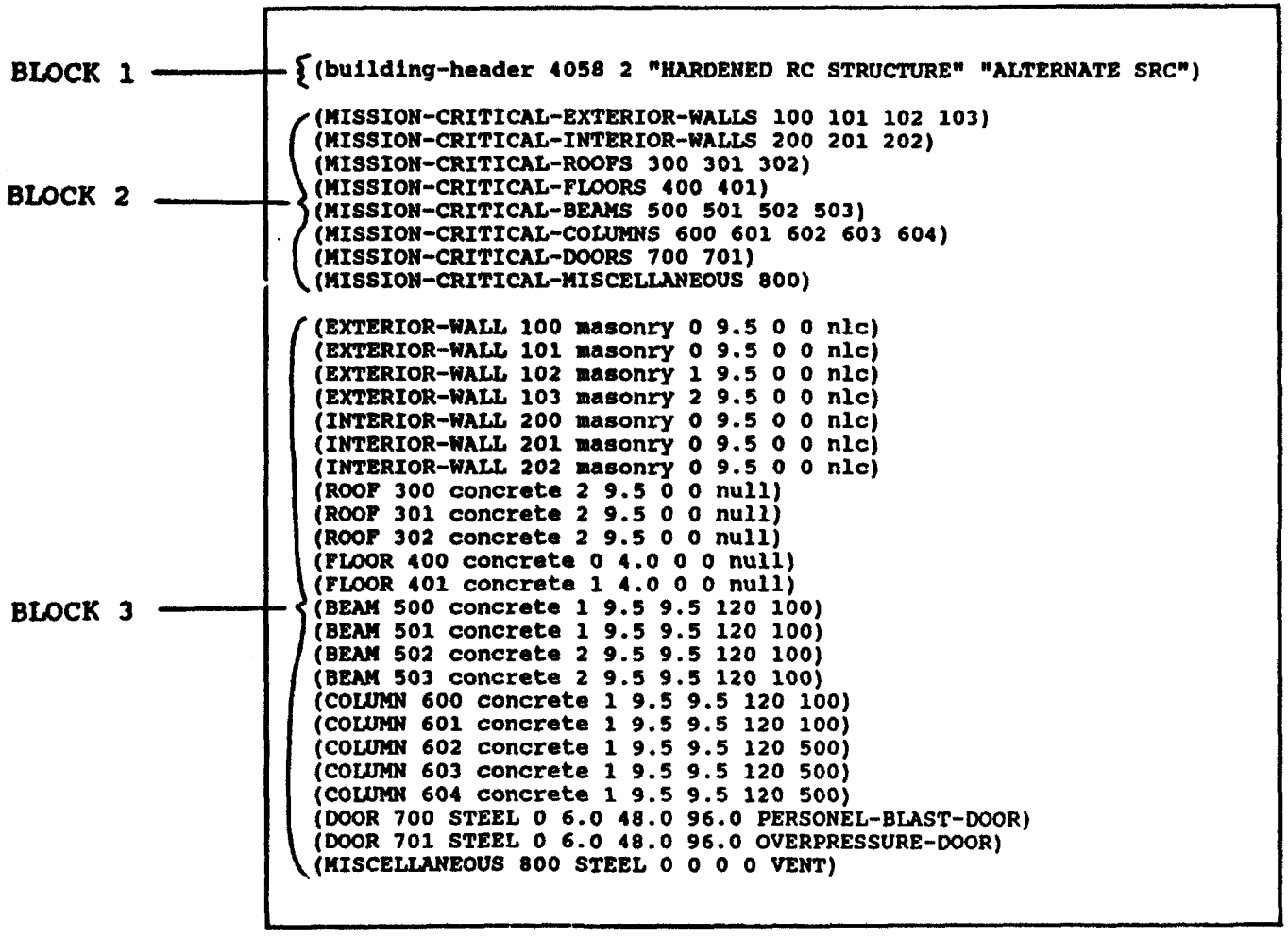


Figure 3.36. POST-DAM Expert System Typical Facility Specific Data File.

<DESCRIPTION>: A general description of the facility's construction.

<FUNCTION>: The function of the mission-critical facility.

BLOCK 2: MISSION-CRITICAL ELEMENT CATEGORY

The second data block is the MISSION-CRITICAL ELEMENT CATEGORY block, and has eight entries. This data block identifies the mission-critical element categories and element numbers within the given facility. Each of the eight data entries must be included, regardless of whether a particular element category appears within the facility. The order and format in which the data must be entered, are given below.

(MISSION-CRITICAL-EXTERIOR-WALLS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-INTERIOR-WALLS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-ROOFS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-FLOORS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-BEAMS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-COLUMNS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-DOORS <LIST OF ELEMENTS>)
(MISSION-CRITICAL-MISCELLANEOUS <LIST OF ELEMENTS>)

where,

<LIST OF ELEMENTS>: A list of elements of the given category within the particular mission-critical facility. This field should be left blank if no element of the given category exists.

BLOCK 3: MISSION-CRITICAL ELEMENT

The third data block is the MISSION-CRITICAL ELEMENT block. There must be one entry for each element in the <LIST OF ELEMENTS> field in each MISSION-CRITICAL ELEMENT CATEGORY block. The format for the MISSION-CRITICAL ELEMENT block is as follows.

(<ELEMENT CATEGORY> <ELEMENT NUMBER> <MATERIAL> <FLOOR>
<DIM1> <DIM2> <DIM3> <VARIABLE>)

where,

<ELEMENT CATEGORY>: The element category being entered. Valid entries are: EXTERIOR-WALL, INTERIOR-WALL, ROOF, FLOOR, BEAM, COLUMN, DOOR, and MISCELLANEOUS.

<ELEMENT NUMBER>: The number assigned to the mission-critical element. These numbers are assigned during the Pre-Damage Assessment of the mission-critical facility, and are obtained from the facility field manual.

<MATERIAL>: The type of material of which the mission-critical element is constructed.

<FLOOR>: The floor level on which the mission-critical element is located. Valid responses are 0 for basement, 1 for ground, 2 for second, etc.

<DIM1>: Dimension in inches. Valid dimensions are as follows:

EXTERIOR-WALL	:	thickness
INTERIOR-WALL	:	thickness
ROOF	:	thickness
FLOOR	:	thickness
BEAM	:	width
COLUMN	:	width
DOOR	:	thickness
MISCELLANEOUS	:	0

<DIM2>: Dimension in inches. Valid dimensions are as follows:

EXTERIOR-WALL	:	0
INTERIOR-WALL	:	0
ROOF	:	0
FLOOR	:	0
BEAM	:	depth
COLUMN	:	depth
DOOR	:	width
MISCELLANEOUS	:	0

<DIM3>: Dimension in inches. Valid dimensions are as follows:

EXTERIOR-WALL	:	0
INTERIOR-WALL	:	0
ROOF	:	0
FLOOR	:	0
BEAM	:	length
COLUMN	:	height
DOOR	:	height
MISCELLANEOUS	:	0

<VARIABLE>: This optional field is used to enter pertinent data on the element. Possibly helpful types of information are as follows:

EXTERIOR-WALL	:	null
INTERIOR-WALL	:	null
ROOF	:	null
FLOOR	:	null

BEAM	:	max. bending moment
COLUMN	:	max. axial force
DOOR	:	null
MISCELLANEOUS	:	description of element

The MISCELLANEOUS data entry in the MISSION-CRITICAL ELEMENT block allows the user to store damage mode information for element categories PDES does not presently recognize. This miscellaneous information is transferred to the POST-DAM System on the Host Computer, so assessment of the damaged element can be handled by a responsible party in the DCC. PDES does not recommend a repair strategy for MISCELLANEOUS elements.

3.5.2.3 Modifying the Contents of the Mission-Critical Facility Data Files

The PDES system memory (DAT subdirectory of the C drive) contains the predamage assessment files for all mission-critical facilities. Section 3.5.2.3.1 discusses the procedure for modifying facility data in the DAT subdirectory. Section 3.5.2.3.2 discusses the procedure for changing the airbase identified in the DAT subdirectory.

3.5.2.3.1 Modifying Mission-Critical Facility Data in the DAT Subdirectory of Drive C

The following procedures should be used to modify the DAT subdirectory of the C drive.

Modifying a Mission-Critical Facility File

To modify a mission-critical facility file, use the following procedure:

a. Modify the MISSION-CRITICAL ELEMENT CATEGORY block of the FACILITY-SPECIFIC DATA FILE (reference Block 2 of Section 3.5.2.2.2) as required.

b. Add or delete the MISSION-CRITICAL ELEMENT block entry, within the FACILITY-SPECIFIC DATA FILE (reference Block 3 of Section 3.5.2.2.2), as required.

Adding a Mission-Critical Facility File

To add a mission-critical facility file to the DAT subdirectory, use the following procedure:

a. Add 1 to the ‹NUMBER› field of the AIRBASE ID block of the AIRBASE-SPECIFIC DATA FILE (reference Block 1 of Section 3.5.2.2.1).

b. Enter the facility number in the ‹FACILITY NUMBERS› field of the FACILITY ID block of the AIRBASE-SPECIFIC DATA FILE (reference Block 2 of Section 3.5.2.2.1).

c. Make a corresponding entry in the FACILITY HEADER block of the AIRBASE-SPECIFIC DATA FILE (reference Block 3 of Section 3.5.2.2.1). The term "corresponding" refers to file location or sequence.

d. Add the facility's FACILITY-SPECIFIC DATA FILE to the DAT subdirectory (reference Section 3.5.3.3.3).

Deleting a Mission-Critical Facility File

To delete a mission-critical facility file from the DAT subdirectory, use the following procedure:

a. Subtract 1 from the <NUMBER> field of the AIRBASE ID block of the AIRBASE-SPECIFIC DATA FILE (reference Block 1 of Section 3.5.2.2.1).

b. Delete the facility number from the <FACILITY NUMBERS> field of the FACILITY ID block of the AIRBASE-SPECIFIC DATA FILE (reference Block 2 of Section 3.5.2.2.1).

c. Remove the facility's FACILITY HEADER block from the AIRBASE-SPECIFIC DATA FILE (reference Block 3 of Section 3.5.2.2.1).

d. Remove the facility's FACILITY-SPECIFIC DATA FILE from the DAT subdirectory (reference Section 3.5.3.3.3).

3.5.2.3.2 Modifying the Data Base to Assess a Different Airbase

To change the airbase on which damage is to be assessed, use the following procedure:

a. Delete the AIRBASE-SPECIFIC DATA FILE and the FACILITY-SPECIFIC DATA FILES from the PDES DAT subdirectory (reference Sections 3.4.2.2.1 and 3.5.2.2.2, respectively).

b. Create a new AIRBASE-SPECIFIC DATA FILE for the airbase on which damage is to be assessed following the procedure defined in Section 3.5.2.2.1.

c. Create the appropriate number of FACILITY-SPECIFIC DATA FILES, as defined in Section 3.5.2.2.2.

APPENDIX A

PD.CLP SOURCE CODE

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;
;;;  PROGRAM TITLE        :  POST-DAM EXPERT SYSTEM (PDES), PD.CLP.
;;;  PROGRAM PURPOSE      :  TO ASSIGN EXPEDIENT REPAIRS TO USAFE AND PACAF
;;;                          MISSION-CRITICAL FACILITIES IN A POST-ATTACK
;;;                          SITUATION.
;;;  PROGRAM VERSION      :  1.02 (910220)
;;;  DEVELOPED BY         :  APPLIED RESEARCH ASSOCIATES, INC.
;;;                          GULF COAST DIVISION.
;;;
;;;  MODIFICATION RECORD  :
;;;
;;;  VERSION     DATE RELEASE    PROGRAMMER            MODIFICATIONS
;;;
;;;   0.10        10/25/89       TOM WARREN     * ORIGINAL VERSION.
;;;                                               DEVELOPED TO ASSESS THE FLOORS,
;;;                                               WALLS, AND COLUMNS AT THE C-74
;;;                                               STRUCTURE AT EGLIN AFB, FL.
;;;   0.11        11/20/89       TOM WARREN     * MATERIALS AVAILABLE AT
;;;                                               BITBURG AB, GERMANY ADDED
;;;   0.12        11/29/89       TOM WARREN     * QUIT OPTION ADDED
;;;   0.13        12/05/89       TOM WARREN     * COMPOSITE ARCH ASSESSMENT ADDED
;;;   0.14        12/20/89       TOM WARREN     * MODIFIED SO ONLY SYSTEM
;;;                                               QUERIES APPEAR ON SCREEN
;;;   0.15        01/31/90       TOM WARREN     * RESOURCE MANAGEMENT REMOVED
;;;                                               FROM EXPERT SYSTEM
;;;   0.16        03/31/90       TOM WARREN     * SYSTEM MODIFIED TO BECOME
;;;                                               A SET OF FACILITY SPECIFIC
;;;                                               SYSTEMS
;;;   0.17        07/31/90       TOM WARREN     * CAPABILITY TO ENTER COMMENTS
;;;                                               ON DAMAGED ELEMENT ADDED
;;;   1.01        12/11/90       JEFF HOWARD    * MAJOR EXPERT SYSTEM DESIGN
;;;                                               PHILOSOPHY CHANGE IMPLEMENTED.
;;;                                             * USE OF STATIC AND DYNAMIC
;;;                                               KNOWLEDGE BASES ADDED TO ENABLE
;;;                                               SYSTEM TO HANDLE ANY NUMBER
;;;                                               OF MISSION-CRITICAL FACILITIES
;;;                                               AND MISSION-CRITICAL ELEMENTS
;;;                                             * ALL POTENTIAL DAMAGE MODES AND
;;;                                               REPAIR STRATEGIES FROM SUBTASK
;;;                                               2.01 ADDED
;;;                                             * MULTI-LEVEL, MENU-DRIVEN
;;;                                               SYSTEM, WITH ERROR DETECTION
;;;                                               RULES UTILIZED
;;;                                             * "RETURN TO PREVIOUS MENU"
;;;                                               OPTION ADDED TO MENUS
;;;                                             * PDES OUTPUT FILES MODIFIED
;;;                                             * USER DEFINED OPTIONAL PDES
;;;                                               UTILITIES ADDED
;;;                                             * ADDITION OF INPUT/OUTPUT
;;;                                               BANNER ON EACH SCREEN
;;;                                             * VERIFICATION OF INPUT ADDED
;;;   1.02        02/15/91       JEFF HOWARD    * HEADER CHANGES
;;;                                             * FILE TRANSFER CAPABILITY ADDED
;;;                                             * MINOR CHANGE IN UTILITY MENU
;;;                                             * MODIFIED REINITIALIZATION RULE
;;;                                             * MODIFIED ELEMENT HEADER CARDS
;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                          INITIALIZATION                          ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(deffacts INITIALIZATION
        (banner logon)
        (building-header 0 0 "null" "null")
        (element-header 0 "null" "null" "null")
        (assessment-number 1)
        (data 0 0 0)
        (setup help-on input-on output-on comm-on)
        (carrage-return 67 0)
        (0 facility-header 0 0 "null" "null" DUMMYCARD)
        (dcc-files no)
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                  PRINT LOGON BANNER TO SCREEN                  ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule PRINT-POSTDAM-LOGON-BANNER
        (declare (salience 9900))
        ?ready <- (banner ?log)
        (setup ?help ?input ?output ?comm)
=>
        (retract ?ready)
        (system "cls")
        (open "c:\\postdam\\dcc\\return.com" ca1 "w")
        (close ca1)
        (open "c:\\postdam\\dcc\\files.dcc" ca2 "w")
        (close ca2)
        (system "type c:\\postdam\\pd\\logon.pd")
        (load-facts "c:\\postdam\\dat\\bitburg.dat")
        (system "type c:\\postdam\\pd\\menu_1.pd")
        (format t "%n%10s%23s" " " "SELECT OPTION 1 TO 3 : ")
        (bind ?response (read))
        (if (eq ?response 3)
            then
            (assert (setup modify 1))
            else (if (eq ?response 2)
                 then
                 (assert (quit level-shell 1))
                 (assert (header 1))
                 else (if (eq ?response 1)
                          then
                          (assert (trigger damaged-bldg-id 1))
                          (assert (header 1))
                          else
                          (format t "%10s%17s%29s" " " "INVALID RESPONSE."
                                    "  HIT < enter > TO CONTINUE. ")
                          (assert (dv1 =(readline)))
                          (assert (banner ?log))
                      )
                 )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;    INPUT DAMAGED BUILDING'S IDENTIFICATION AND TEST TO     ;;;;;;;;
;;;;;;;;       DETERMINE IF THE FACILITY IS MISSION CRITICAL        ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule DAMAGED-BUILDING-IDENTITY
        ?ready1 <- (trigger damaged-bldg-id ?phase)
        ?ready2 <- (building-header ?bldg-number ?bldg-priority
```

```
                ?bldg-description ?bldg-function)
(bitburg-ab number-of-mission-critical-facilities
            ?number-of-facility-cards)
(mission-critical-facilities $?bldg-numbers)
(setup ?help ?input ?output ?comm)
=>
(retract ?ready1)
(if (eq ?phase 1)
    then
    (if (eq ?help help-on)
        then
        (system "type c:\\postdam\\pd\\menu_2h.pd")
        else
        (system "type c:\\postdam\\pd\\menu_2.pd")
    )
    (format t "%n%n%10s%23s" " " "SELECT OPTION 1 TO 4 : ")
    (bind ?response (read))
    (if (eq ?response 4)
        then
        (assert (quit level-shell 1))
        else
        (if (eq ?response 3)
            then
            (assert (banner logon))
            else
            (if (eq ?response 2)
                then
                (if(eq ?help help-on)
                   then
                   (assert (utility help-1 ?number-of-facility-cards 1))
                   else
                   (format t "%n%n%10s%25s%30s"
                             " " "HELP UTILITY IS DISABLED."
                             "  HIT < enter > TO CONTINUE : ")
                   (assert (dv1 =(readline)))
                   (assert (trigger damaged-bldg-id 1))
                   (assert (header 1))
                )
                else
                (if (eq ?response 1)
                    then
                    (bind ?phase 2)
                    (format t "%n%n%10s%18s" " " "FACILITY NUMBER : ")
                    else
                    (format t "%n%n%10s%17s%29s" " " "INVALID RESPONSE."
                              "  HIT < enter > TO CONTINUE. ")
                    (assert (dv1 =(readline)))
                    (assert (trigger damaged-bldg-id 1))
                    (assert (header 1))
                )
            )
        )
    )
)
(if (eq ?phase 2)
    then
    (bind ?bldg-number (read))
    (retract ?ready2)
    (if (> (member ?bldg-number $?bldg-numbers) 0)
            then
            (load-facts
                (str_cat "c:\\postdam\\dat\\bldg" ?bldg-number ".dat"))
            (assert (open-files yes))
            else
            (if (numberp ?bldg-number)
```

```
                    then
                    (format t "%n%10s%9s%4d%22s%n%10s%35s%n%n%10s%28s"
                       " " "BUILDING " ?bldg-number " IS NOT ON THE MISSION"
                       " " "CRITICAL FACILITY LIST OF POST-DAM."
                       " " "HIT < enter > TO CONTINUE : ")
                    else
                    (bind ?bldg-number 0)
                    (format t "%n%10s%17s%29s" " " "INVALID RESPONSE."
                                HIT < enter > TO CONTINUE. ")
                )
                (assert (dv1 =(readline)))
                (assert (building-header ?bldg-number ?bldg-priority
                          ?bldg-description ?bldg-function))
                (assert (trigger damaged-bldg-id 1))
                (assert (header 1))
            )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                    OPEN OUTPUT FILES                        ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule OPEN-OUTPUT-FILES
        ?ready1 <- (open-files yes)
        ?ready2 <- (carrage-return ?lines ?line-feed)
        (building-header ?bldg-number ?bldg-priority
                         ?bldg-description ?bldg-function)
=>
        (retract ?ready1 ?ready2)
        (open (str_cat "c:\\postdam\\b" ?bldg-number ".out") ta1 "w")
        (open (str_cat "c:\\postdam\\b" ?bldg-number ".mat") ta2 "w")
        (open (str_cat "c:\\postdam\\b" ?bldg-number ".eqp") ta3 "w")
        (format ta1 "%n%n%56s%n%45s%5d%n%52s%n"
                    "POST-ATTACK DAMAGE ASSESSMENT OF"
                    "FACILITY NUMBER" ?bldg-number
                    "BITBURG AIR BASE, GERMANY")
        (fprintout ta1 "
                       _____
                      _____" crlf crlf)
        (format ta1 "%n I.) GENERAL FACILITY INFORMATION%n%n")
        (fprintout ta1 "     Function    :  " ?bldg-function crlf)
        (fprintout ta1 "     Priority    :  " ?bldg-priority crlf)
        (fprintout ta1 "     Description :  " ?bldg-description)
        (format ta1 "%n%nII.) DAMAGE ASSESSMENTS%n%n")
        (bind ?line-feed (+ ?line-feed 16))
        (assert (carrage-return ?lines ?line-feed))
        (assert (bldg-disp ?bldg-number yes))
        (assert (header 2))
)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;        DETERMINE IF BUILDING IS A CANIDATE FOR ONE          ;;;;;;;;
;;;;;;;;            OF THE EXPEDIENT REPAIR STRATEGIES              ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule BLDG-DISPOSITION
        ?ready <- (bldg-disp ?bldg-number yes)
        (setup ?help ?input ?output ?comm)
=>
        (retract ?ready)
        (system "type c:\\postdam\\pd\\menu_3.pd")
        (format t "%n%n%10s%23s" " " "SELECT OPTION 1 TO 4 : ")
        (bind ?response (read))
        (if (eq ?response 4)
            then
            (assert (trigger damaged-bldg-id 1))
```

```
            (assert (quit level-building 1))
            (assert (header 1))
            else
            (if (eq ?response 3)
                then
                (assert (trigger damaged-bldg-id 1))
                (assert (quit level-building 1))
                (assert (header 1))
                else
                (if (eq ?response 2)
                    then
                    (assert (output-data 0 0 0 0 0 0 0 0 0 0 0 0 0
                                         "BUILDING BEYOND EXPEDIENT REPAIR"))
                    (assert (output-files repaired-no))
                    (assert (header 1))
                    else
                    (if (eq ?response 1)
                        then
                        (assert (damaged-element-category query-yes))
                        (assert (header 2))
                        else
                        (format t "%10s%17s%29s" " " "INVALID RESPONSE."
                                "  HIT < enter > TO CONTINUE. ")
                        (assert (dv1 =(readline)))
                        (assert (bldg-disp ?bldg-number yes))
                        (assert (header 2))
                    )
                )
            )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;        CATEGORIZATION OF MISSION CRITICAL ELEMENTS          ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule CATEGORIZATION-OF-MISSION-CRITICAL-ELEMENTS
        ?ready1 <- (damaged-element-category query-yes)
        (building-header ?bldg-number ?bldg-priority
                         ?bldg-description ?bldg-function)
        ?ready2 <- (element-header ?element-number ?description
                                   ?damage-mode ?repair)
=>
        (retract ?ready1 ?ready2)
        (system "type c:\\postdam\\pd\\menu_4.pd")
        (format t "%n%6s%32s" " " "SELECT AN OPTION 1 THROUGH 10 : ")
        (bind ?selection (read))
        (if (or (eq ?selection 1)
                (eq ?selection 2)
                (eq ?selection 3)
                (eq ?selection 4)
                (eq ?selection 5)
                (eq ?selection 6)
                (eq ?selection 7)
                (eq ?selection 8)
                (eq ?selection 9) )
            then
            (if (eq ?selection 1)
                then
                (assert (element-number-verify EXTERIOR-WALL
                                MISSION-CRITICAL-EXTERIOR-WALLS))
                (assert (element-header ?element-number "EXTERIOR WALL"
                                        ?damage-mode ?repair))
                (assert (header 2.5))
            )
```

```
(if (eq ?selection 2)
    then
    (assert (element-number-verify INTERIOR-WALL
                    MISSION-CRITICAL-INTERIOR-WALLS))
    (assert (element-header ?element-number "INTERIOR WALL"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 3)
    then
    (assert (element-number-verify ROOF
                    MISSION-CRITICAL-ROOFS))
    (assert (element-header ?element-number "ROOF"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 4)
    then
    (assert (element-number-verify FLOOR
                    MISSION-CRITICAL-FLOORS))
    (assert (element-header ?element-number "FLOOR"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 5)
    then
    (assert (element-number-verify BEAM
                    MISSION-CRITICAL-BEAMS))
    (assert (element-header ?element-number "BEAM"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 6)
    then
    (assert (element-number-verify COLUMN
                    MISSION-CRITICAL-COLUMNS))
    (assert (element-header ?element-number "COLUMN"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 7)
    then
    (assert (element-number-verify DOOR
                    MISSION-CRITICAL-DOORS))
    (assert (element-header ?element-number "DOOR"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 8)
    then
    (assert (element-number-verify MISCELLANEOUS
                    MISSION-CRITICAL-MISCELLANEOUS))
    (assert (element-header ?element-number "MISCELLANEOUS"
                            ?damage-mode ?repair))
    (assert (header 2.5))
)
(if (eq ?selection 9)
    then
    (assert (bldg-disp ?bldg-number yes))
    (assert (element-header ?element-number ?description
                    ?damage-mode ?repair))
    (assert (header 2))
)
else
(if (eq ?selection 10)
```

```
                then
                (assert (building-header 0 0 "null" "null"))
                (assert (trigger damaged-bldg-id 1))
                (assert (header 1))
                (assert (quit level-building 1))
                else
                (format t "%6s%17s%29s" " " "INVALID RESPONSE."
                          "  HIT < enter > TO CONTINUE. ")
                (assert (dv1 =(readline)))
                (assert (damaged-element-category query-yes))
                (assert (element-header ?element-number ?description
                                        ?damage-mode ?repair))
                (assert (header 2))
            )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;        MISSION CRITICAL ELEMENT NUMBER VERIFICATION        ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule MISSION-CRITICAL-ELEMENT-NUMBER-VERIFICATION
        ?ready1 <- (element-number-verify ?element-data ?category)
        ?ready2 <- (element-header ?element-number ?description
                                   ?damage-mode ?repair)
        ?ready3 <- (data ?width ?height ?length)
        (?category $?valid-numbers)
        (setup ?help ?input ?output ?comm)
=>
        (retract ?ready1 ?ready2 ?ready3)
        (bind ?temp (length (mv-append $?valid-numbers)))
        (if (< ?temp 1)
            then
            (fprintout t crlf "THERE ARE NO " ?category " IN THE FACILITY"
                       " BEING ASSESSED." crlf "HIT < enter > TO CONTINUE : ")
            (assert (dv1 =(readline)))
            (assert (element-header ?element-number ?description
                                    ?damage-mode ?repair))
            (assert (data ?width ?height ?length))
            (assert (damaged-element-category query-yes))
            (assert (header 2))
            else
            (if (eq ?help help-on)
                then
                (system "type c:\\postdam\\pd\\menu_5h.pd")
                else
                (system "type c:\\postdam\\pd\\menu_5.pd")
            )
            (format t "%n%n%10s%23s" " " "SELECT OPTION 1 TO 4 : ")
            (bind ?response (read))
            (if (or (eq ?response 1)
                    (eq ?response 2)
                    (eq ?response 3)
                    (eq ?response 4)
                )
                then
                (if (or (eq ?response 1)
                        (eq ?response 2)
                    )
                    then
                    (bind ?test 0)
                    (if (eq ?response 2)
                        then
                        (if (eq ?help help-off)
                            then
```

```
            (format t "%10s%48s" " "
             "HELP OPTION DISABLED.  HIT <enter> TO CONTINUE: ")
            (bind ?element-number (readline))
            (bind ?test 1)
            else
            (fprintout t "VALID MISSION CRITICAL " ?description
                         " ELEMENT NUMBERS ARE AS FOLLOWS: "
                         crlf $?valid-numbers)
            (fprintout t crlf "ENTER VALID ELEMENT NUMBER: ")
            (bind ?element-number (read))
        )
    )
    (if (eq ?response 1)
        then
        (format t "%10s%31s"
                " " "ENTER DAMAGED ELEMENT NUMBER : ")
        (bind ?element-number (read))
    )
    (if (> (member ?element-number $?valid-numbers) 0)
        then
        (assert (data ?width ?height ?length))
        (assert (damage-mode-assessment ?element-data
                                        ?category))
        (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
        (assert (header 3))
        else
        (if (numberp ?element-number)
            then
            (fprintout t "          " "ELEMENT NUMBER "
                 ?element-number
                " IS NOT A MISSION CRITICAL ELEMENT."
                 crlf "          " "HIT <enter> TO CONTINUE: ")
                 (assert (dvl =(readline)))
            else
            (if (eq ?test 1)
                then
                else
                (format t "%10s%17s%29s" " " " "INVALID RESPONSE."
                          "  HIT < enter > TO CONTINUE. ")
                (assert (dvl =(readline)))
            )
        )
        (assert (data ?width ?height ?length))
        (assert (element-number-verify ?element-data ?category))
        (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
        (assert (header 2.5))
    )
)
(if (eq ?response 3)
    then
    (assert (element-header ?element-number ?description
                    ?damage-mode ?repair))
    (assert (data ?width ?height ?length))
    (assert (damaged-element-category query-yes))
    (assert (header 2))
)
(if (eq ?response 4)
    then
    (assert (element-header ?element-number ?description
                    ?damage-mode ?repair))
    (assert (data ?width ?height ?length))
    (assert (quit level-building 1))
)
```

```
                else
                (format t "%10s%17s%29s" " " "INVALID RESPONSE."
                          " HIT < enter > TO CONTINUE. ")
                (assert (dv1 =(readline)))
                (assert (element-number-verify ?element-data ?category))
                (assert (element-header ?element-number ?description
                                        ?damage-mode ?repair))
                (assert (data ?width ?height ?length))
                (assert (header 2.5))
            )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;                  DAMAGE MODE ASSESSMENTS                    ;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule DAMAGE-MODE-ASSESSMENTS
        ?ready1 <- (damage-mode-assessment ?element-data ?category)
        ?ready2 <- (element-header ?element-number ?description
                        ?damage-mode ?repair)
        (assessment-number ?assessment)
        (?element-data ?element-number ?mat ?floor $?)
=>
        (retract ?ready1 ?ready2)
        (if (eq ?category MISSION-CRITICAL-EXTERIOR-WALLS)
            then
            (system "type c:\\postdam\\pd\\menu_6ew.pd")
        )
        (if (eq ?category MISSION-CRITICAL-INTERIOR-WALLS)
            then
            (system "type c:\\postdam\\pd\\menu_6iw.pd")
        )
        (if (eq ?category MISSION-CRITICAL-ROOFS)
            then
            (system "type c:\\postdam\\pd\\menu_6r.pd")
        )
        (if (eq ?category MISSION-CRITICAL-FLOORS)
            then
            (system "type c:\\postdam\\pd\\menu_6f.pd")
        )
        (if (eq ?category MISSION-CRITICAL-BEAMS)
            then
            (system "type c:\\postdam\\pd\\menu_6b.pd")
        )
        (if (eq ?category MISSION-CRITICAL-COLUMNS)
            then
            (system "type c:\\postdam\\pd\\menu_6c.pd")
        )
        (if (eq ?category MISSION-CRITICAL-DOORS)
            then
            (system "type c:\\postdam\\pd\\menu_6d.pd")
        )
        (if (eq ?category MISSION-CRITICAL-MISCELLANEOUS)
            then
            (system "type c:\\postdam\\pd\\menu_6m.pd")
        )
        (if (eq ?category MISSION-CRITICAL-MISCELLANEOUS)
            then
            (format t "%n%n%10s%20s" " " "ENTER OPTION 1 TO 3 : ")
            (bind ?number 3)
            else
            (if (eq ?category MISSION-CRITICAL-DOORS)
                then
                (format t "%n%n%10s%20s" " " "ENTER OPTION 1 TO 4 : ")
```

```
        (bind ?number 4)
        else
        (if (eq ?category MISSION-CRITICAL-COLUMNS)
            then
            (format t "%n%n%10s%20s" " " "ENTER OPTION 1 TO 8 : ")
            (bind ?number 8)
            else
            (format t "%n%n%10s%20s" " " "ENTER OPTION 1 TO 7 : ")
            (bind ?number 7)
        )
    )
)
(bind ?response (read))
(if (eq ?number 8)
    then
    (bind ?test (member ?response (mv-append 1 2 3 4 5 6 7 8)))
    else
    (if (eq ?number 7)
        then
        (bind ?test (member ?response (mv-append 1 2 3 4 5 6 7)))
        else
        (if (eq ?number 4)
            then
            (bind ?test (member ?response (mv-append 1 2 3 4)))
            else
            (bind ?test (member ?response (mv-append 1 2 3)))
        )
    )
)
(if (eq ?test 0)
    then
    (format t "%10s%17s%29s" " " "INVALID RESPONSE."
              "  HIT < enter > TO CONTINUE. ")
    (assert (dv3 =(readline)))
    (assert (damage-mode-assessment ?element-data ?category))
    (assert (element-header ?element-number ?description
                            ?damage-mode ?repair))
    (assert (header 3))
    else
    (if (or (eq ?category MISSION-CRITICAL-EXTERIOR-WALLS)
            (eq ?category MISSION-CRITICAL-INTERIOR-WALLS)
            (eq ?category MISSION-CRITICAL-ROOFS)
        )
        then
        (if (eq ?response 1)
            then
            (assert (element-header ?element-number ?description
                        "EXCESSIVE CRACKING" "SHOTCRETE SEAL"))
            (assert (input-data on))
            (assert (header 4))
        )
        (if (eq ?response 2)
            then
            (assert (element-header ?element-number ?description
                        "SMALL HOLE" "PLYWOOD COVER"))
            (assert (input-data on))
            (assert (header 4))
        )
        (if (eq ?response 3)
            then
            (if (eq ?category MISSION-CRITICAL-ROOFS)
                then
                (assert (element-header ?element-number ?description
                            "ROOF BREACH" "SHOTCRETE HORIZ"))
                else
```

```
            (assert (element-header ?element-number ?description
                    "WALL BREACH" "SHOTCRETE VERTICAL"))
        )
        (assert (input-data on))
        (assert (header 4))
    )
)
(if (eq ?category MISSION-CRITICAL-FLOORS)
    then
    (if (eq ?response 1)
        then
        (if (eq ?floor 0)
           then
            (assert (element-header ?element-number ?description
                    "EXCESSIVE CRACKING" "PLYWOOD COVER"))
            else
            (assert (element-header ?element-number ?description
                    "EXCESSIVE CRACKING" "SHORE FLOOR"))
        )
        (assert (input-data on))
        (assert (header 4))
    )
    (if (eq ?response 2)
        then
        (assert (element-header ?element-number ?description
                    "SMALL HOLE" "PLYWOOD COVER"))
        (assert (input-data on))
        (assert (header 4))
    )
    (if (eq ?response 3)
        then
        (assert (element-header ?element-number ?description
                    "LARGE HOLE" "SHOTCRETE HORIZ"))
        (assert (input-data on))
        (assert (header 4))
    )
)
(if (eq ?category MISSION-CRITICAL-BEAMS)
    then
    (if (eq ?response 1)
        then
        (assert (element-header ?element-number ?description
                    "EXCESSIVE DEFORMATION" "null"))
        (assert (beam-connection-query on))
        (assert (header 4))
    )
    (if (eq ?response 2)
        then
        (assert (element-header ?element-number ?description
                    "BEAM FAILURE" "COLUMN SHORE"))
        (assert (input-data on))
        (assert (header 4))
    )
    (if (eq ?response 3)
        then
        (assert (element-header ?element-number ?description
                    "CONNECTION FAILURE" "KNEE-BRACE"))
        (assert (input-data on))
    )
)
(if (eq ?category MISSION-CRITICAL-COLUMNS)
    then
    (if (eq ?response 1)
        then
        (assert (element-header ?element-number ?description
```

```
                    "SPALLING" "SHOTCRETE COLUMN"))
            (assert (input-data on))
            (assert (header 4))
        )
        (if (eq ?response 2)
            then
            (assert (element-header ?element-number ?description
                    "CRACKING/STEEL DEBONDING" "COLUMN SPLINT"))
            (assert (input-data on))
        )
        (if (eq ?response 3)
            then
            (assert (element-header ?element-number ?description
                    "MAJOR DAMAGE / MISSING" "COLUMN SHORE"))
            (assert (input-data on))
            (assert (header 4))
        )
        (if (eq ?response 4)
            then
            (assert (element-header ?element-number ?description
                    "CONNECTION FAILURE" "KNEE-BRACE"))
            (assert (input-data on))
        )
)
(if (eq ?category MISSION-CRITICAL-DOORS)
   then
   (format t "%n%10s%57s%n%10s%28s"
    " " "THIS SECTION INCOMPLETE IN PROTOTYPE VERSION OF POST-DAM."
     " " "HIT < enter > TO CONTINUE : ")
   (assert (dv1 =(readline)))
   (assert (element-header ?element-number ?description
                    ?damage-mode ?repair))
   (assert (damaged-element-category query-yes))
   (assert (header 2))
)
(if (eq ?category MISSION-CRITICAL-MISCELLANEOUS)
   then
   (format t "%n%10s%57s%n%10s%28s"
    " " "THIS SECTION INCOMPLETE IN PROTOTYPE VERSION OF POST-DAM."
    " " "HIT < enter > TO CONTINUE : ")
   (assert (dv1 =(readline)))
   (assert (element-header ?element-number ?description
                    ?damage-mode ?repair))
   (assert (damaged-element-category query-yes))
   (assert (header 2))
)
(if (or (eq ?category MISSION-CRITICAL-EXTERIOR-WALLS)
        (eq ?category MISSION-CRITICAL-INTERIOR-WALLS)
        (eq ?category MISSION-CRITICAL-ROOFS)
        (eq ?category MISSION-CRITICAL-FLOORS)
        (eq ?category MISSION-CRITICAL-BEAMS)
    )
    then
    (if (eq ?response 4)
        then
        (assert (element-header ?element-number ?description
                    "UNPREDICTED DAMAGE MODE" "UNDETERMINED"))
        (assert (input-data on))
    )
    (if (eq ?response 5)
        then
        (assert (element-header ?element-number ?description
            "ELEMENT BEYOND REPAIR" "BEYOND REPAIR"))
        (assert (input-data on))
    )
```

```
                (if (eq ?response 6)
                    then
                    (assert (damage-mode-assessment ?element-data ?category))
                    (assert (element-header ?element-number ?description
                        ?damage-mode ?repair))
                    (assert (element-number-verify ?element-data ?category))
                    (assert (header 2.5))
                )
                (if (eq ?response 7)
                    then
                    (assert (damage-mode-assessment ?element-data ?category))
                    (assert (element-header ?element-number ?description
                        ?damage-mode ?repair))
                    (assert (quit level-element 1))
                )
            )
            (if (eq ?category MISSION-CRITICAL-COLUMNS)
                then
                (if (eq ?response 5)
                    then
                    (assert (element-header ?element-number ?description
                        "UNPREDICTED DAMAGE MODE" "UNDETERMINED"))
                    (assert (input-data on))
                )
                (if (eq ?response 6)
                    then
                    (assert (element-header ?element-number ?description
                        "ELEMENT BEYOND REPAIR" "BEYOND REPAIR"))
                    (assert (input-data on))
                )
                (if (eq ?resporse 7)
                    then
                    (assert (damage-mode-assessment ?element-data ?category))
                    (assert (element-header ?element-number ?description
                        ?damage-mode ?repair))
                    (assert (element-number-verify ?element-data ?category))
                    (assert (header 2.5))
                )
                (if (eq ?response 8)
                    then
                    (assert (damage-mode-assessment ?element-data ?category))
                    (assert (element-header ?element-number ?description
                        ?damage-mode ?repair))
                    (assert (quit level-element 1))
                )
            )
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;    SUB-RULES FOR BEAM-DAMAGE-MODES-AND-EXPEDIENT-REPAIRS   ;;;;;;;;
;;;;;;;;   DETERMINATION OF BEAM CONNECTIONS AND EXPEDIENT REPAIR   ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

;;;;;;;;          DETERMINATION OF BEAM CONNECTION TYPE           ;;;;;;;;

(defrule BEAM-CONNECTION-QUERY
        ?ready1 <- (beam-connection-query on)
        ?ready2 <- (element-header ?element-number ?description
                        ?damage-mode ?repair)
        (assessment-number ?assessment)
=>
        (retract ?ready1 ?ready2)
        (format t "%21s%29s%3d%2s" " " "DESCRIBE CONNECTIONS OF BEAM "
                        ?element-number " :")
```

```
        (system "type c:\\postdam\\pd\\menu_7.pd")
        (format t "%n%10s%20s" " " "ENTER OPTION 1 TO 7 : ")
        (bind ?response (read))
        (if (= (member ?response (mv-append 1 2 3 4 5 6 7)) 0)
            then
            (format t "%10s%17s%29s" " " "INVALID RESPONSE."
                      "  HIT < enter > TO CONTINUE. ")
            (assert (dv1 =(readline)))
            (assert (element-header ?element-number ?description
                                    ?damage-mode ?repair))
            (assert (beam-connection-query on))
            (assert (header 4))
            else
            (if (eq ?response 1)
                then
                (assert (column-access on))
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
                (assert (header 4))
            )
            (if (eq ?response 2)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "KNEE-BRACE")))
            (if (eq ?response 3)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "REMOVE WALL")))
            (if (eq ?response 4)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "KNEE-BRACE")))
            (if (eq ?response 5)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "REMOVE WALL")))
            (if (eq ?response 6)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "REMOVE WALL")))
            (if (eq ?response 7)
                then (assert (element-header ?element-number ?description
                                ?damage-mode "UNDETERMINED"))
                     (assert (input-data on)))
            (if (or (eq ?response 1)
                    (eq ?response 7)
                )
                then
                else
                (assert (input-data on))
                (assert (header 4))
            )
        )
)

;;;;;;;;    DETERMINATION OF COLUMN ACCESSIBILITY FOR PURPOSE OF    ;;;;;;;;
;;;;;;;;  DECIDING THE EXPEDIENT REPAIR STRATEGY FOR DAMAGED BEAM   ;;;;;;;;

(defrule COLUMN-ACCESS
        ?ready1 <- (column-access on)
        ?ready2 <- (element-header ?element-number ?description
                        ?damage-mode ?repair)
        (assessment-number ?assessment)
=>
        (retract ?ready1 ?ready2)
        (fprintout t crlf "IS THERE ACCESS TO ALL (4) SIDES OF"
                          " BOTH COLUMNS?"
                   crlf " ENTER < yes > OR < no > : ")
        (bind ?response (read))
        (if (or (eq ?response yes)
```

```
                (eq ?response y))
                    then (assert (element-header ?element-number ?description
                                        ?damage-mode "KING-POST"))
                         (assert (input-data on))
                         (assert (header 4))
        )
        (if (or (eq ?response no)
                (eq ?response n))
                    then (assert (element-header ?element-number ?description
                                        ?damage-mode "KNEE-BRACE"))
                         (assert (input-data on))
        )
        (if (not (or (eq ?response yes)
                     (eq ?response no)
                     (eq ?response y)
                     (eq ?response n)))
                        then
                        (fprintout t crlf
                                    ?response " IS NOT A VALID RESPONSE."
                                    "  HIT < enter > TO CONTINUE: ")
                        (bind ?response (read))
                        (assert (column-access on))
                        (assert (element-header ?element-number ?description
                                                ?damage-mode ?repair))
                        (assert (header 4))
        )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                    INPUT DATA AND CHECK                      ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

;;;;;;;;                         INPUT DATA                           ;;;;;;;;

(defrule INPUT-DATA
        ?ready1 <- (input-data on)
        ?ready2 <- (element-header ?element-number ?description
                                   ?damage-mode ?repair)
        (or (EXTERIOR-WALL ?element-number ?mat ?floor $?)
            (INTERIOR-WALL ?element-number ?mat ?floor $?)
            (ROOF ?element-number ?mat ?floor $?)
            (FLOOR ?element-number ?mat ?floor $?)
            (COLUMN ?element-number ?mat ?floor $?)
            (BEAM ?element-number ?mat ?floor $?)
        )
=>
        (retract ?ready1)
        (bind ?width 0)
        (bind ?height 0)
        (bind ?length 0)
        (if (or (eq ?repair "KNEE-BRACE")
                (eq ?repair "COLUMN SPLINT")
                (eq ?repair "UNDETERMINED")
                (eq ?repair "BEYOND REPAIR")
            )
            then
            else
            (fprintout t crlf "ENTER APPROXIMATE DIMENSION(S) (in feet) "
                        "OF THE DAMAGED AREA: " crlf crlf)
        )
        (if (eq ?repair "PLYWOOD COVER")
            then
            (fprintout t "WIDTH = ")
            (bind ?width (read))
            (if (or (eq ?description "EXTERIOR WALL")
```

```
            (eq ?description "INTERIOR WALL")
        )
        then
        (fprintout t "HEIGHT = ")
        (bind ?height (read))
        else
        (fprintout t "LENGTH = ")
        (bind ?length (read))
    )
)
(if (eq ?repair "SHOTCRETE SEAL")
    then
    (fprintout t "LENGTH OF AREA TO BE SEALED = ")
    (bind ?length (read))
    (fprintout t "WIDTH OF AREA TO BE SEALED = ")
    (bind ?width (read))
)
(if (eq ?repair "SHOTCRETE VERTICAL")
    then
    (fprintout t "WIDTH = ")
    (bind ?width (read))
    (fprintout t "HEIGHT = ")
    (bind ?height (read))
)
(if (eq ?repair "SHOTCRETE HORIZ")
    then
    (fprintout t "WIDTH = ")
    (bind ?width (read))
    (fprintout t "LENGTH = ")
    (bind ?length (read))
    (if (eq ?floor 0)
        then
        else
        (if (eq ?description FLOOR)
            then
            (fprintout t "DISTANCE BETWEEN DAMAGED FLOOR: " ?floor
                         " AND FLOOR " =(- ?floor 1) " IS = ")
            else
            (fprintout t "DISTANCE BETWEEN DAMAGED ROOF"
                         " AND FLOOR IS = ")
        )
        (bind ?height (read))
    )
)
(if (eq ?repair "SHORE FLOOR")
    then
    (fprintout t "WIDTH OF CRACKED FLOOR AREA = ")
    (bind ?width (read))
    (fprintout t "LENGTH OF CRACKED FLOOR AREA = ")
    (bind ?length (read))
    (fprintout t "DISTANCE BETWEEN DAMAGED FLOOR: " ?floor
                 " AND FLOOR " =(- ?floor 1) " IS : ")
    (bind ?height (read))
)
(if (or (eq ?repair "COLUMN SHORE")
        (eq ?repair "REMOVE WALL")
    )
    then
    (if (eq ?description "BEAM")
        then
        (retract ?ready2)
        (assert (element-header ?element-number ?description
                                ?damage-mode "COLUMN SHORE"))
        (fprintout t "HEIGHT FROM FLOOR TO DAMAGED BEAM = ")
        (bind ?height (read))
```

```
            )
            (if (eq ?description "COLUMN")
                then
                (fprintout t "HEIGHT OF DAMAGED COLUMN = ")
                (bind ?height (read))
            )
        )
        (if (eq ?repair "KING-POST")
            then
            (fprintout t "LENGTH OF DAMAGED BEAM = ")
            (bind ?length (read))
        )
        (if (eq ?repair "SHOTCRETE COLUMN")
            then
            (fprintout t "APPROXIMATE LENGTH ALONG"
                         " COLUMN EFFECTED BY SPALLING = ")
            (bind ?length (read))
        )
        (assert (input-data-test ?width ?length ?height))
)

;;;;;;;;                    INPUT DATA TEST                    ;;;;;;;;

(defrule INPUT-DATA-TEST
        ?ready1 <- (input-data-test ?width ?length ?height)
        ?ready2 <- (data $?)
        (element-header ?element-number ?description ?damage-mode ?repair)
=>
        (retract ?ready1 ?ready2)
        (bind ?error1 false)
        (bind ?error2 false)
        (bind ?error3 false)
        (bind ?error4 false)
        (bind ?error5 false)
        (bind ?error6 false)
        (if (not (and (numberp ?width)
                      (numberp ?height)
                      (numberp ?length)
                      (>= ?width 0)
                      (>= ?height 0)
                      (>= ?length 0)
                 )
            )
            then
            (if (not (numberp ?width) )
                then (bind ?error1 true)
                else (if (not (>= ?width 0) )
                     then (bind ?error4 true) ) )
            (if (not (numberp ?height) )
                then (bind ?error2 true)
                else (if (not (>= ?height 0) )
                     then (bind ?error5 true) ) )
            (if (not (numberp ?length) )
                then (bind ?error3 true)
                else (if (not (>= ?length 0) )
                     then (bind ?error6 true) ) )
            (fprintout t crlf crlf "   * * ERROR * *")
            (if (or (eq ?error1 true)
                    (eq ?error2 true)
                    (eq ?error3 true) )
                then
                (if (eq ?error1 true)
                    then (fprintout t crlf "    WIDTH = " ?width) )
                (if (eq ?error2 true)
                    then (fprintout t crlf "    HEIGHT = " ?height) )
```

```
            (if (eq ?error3 true)
                then (fprintout t crlf "    LENGTH = " ?length) )
            (fprintout t crlf "    WAS ENTERED."
                       crlf " DIMENSION MUST BE"
                       crlf "     A NUMERIC." crlf)
        )
        (if (or (eq ?error4 true)
                (eq ?error5 true)
                (eq ?error6 true) )
            then
            (if (eq ?error4 true)
                then (fprintout t crlf "    WIDTH = " ?width) )
            (if (eq ?error5 true)
                then (fprintout t crlf "    HEIGHT = " ?height) )
            (if (eq ?error6 true)
                then (fprintout t crlf "    LENGTH = " ?length) )
            (fprintout t crlf "    WAS ENTERED."
                       crlf " DIMENSION MUST BE"
                       crlf " GREATER THAN ZERO." crlf)
        )
        (fprintout t crlf "    HIT <enter>" crlf
                          "   TO CONTINUE: ")
        (assert (dv1 =(readline)))
        (assert (header 3))
        (assert (data ?width ?height ?length))
        (assert (input-data on))
        else
        (assert (repair-strategy-assignment on))
        (assert (data ?width ?height ?length))
        (assert (header 5))
    )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                    REPAIR STRATEGIES                        ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule REPAIR-STRATEGIES-SECTION-1

    ?ready1 <- (repair-strategy-assignment on)
    ?ready2 <- (element-header ?element-number ?description
                   ?damage-mode ?repair)
    (building-header ?bldg-number ?bldg-priority ?bldg-description
                    ?bldg-function)
    (data ?width ?height ?length)
    (setup ?help ?input ?output ?comm)
    (or (EXTERIOR-WALL ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3
                   ?variable)
        (INTERIOR-WALL ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3
                   ?variable)
        (ROOF ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3 ?variable)
        (FLOOR ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3 ?variable)
    )
=>
    (retract ?ready1 ?ready2)
    (if (eq ?input input-on)
        then
        (fprintout t crlf "IS THE INPUT INFORMATION GIVEN ABOVE CORRECT ?"
                   crlf "ENTER < yes > OR < no > : ")
        (bind ?response (read))
        else
        (bind ?response yes)
    )
    (if (or (eq ?response yes)
            (eq ?response y)
```

```
    )
    then
    (fprintout t crlf "ENTER ANY APPLICABLE REMARKS ABOUT THIS "
                "ASSESSMENT" crlf "(or hit < enter > to continue): ")
    (bind ?remarks (readline))
)
(if (or (eq ?response no)
        (eq ?response n) )
        then
        (fprintout t crlf crlf "INPUT DATA IS INCORRECT."
                   "  HIT < enter > TO CONTINUE. ")
        (assert (dv1 =(readline)))
        (assert (building-header ?bldg-number ?bldg-priority
                        ?bldg-description ?bldg-function))
        (assert (element-header 0 "null" "null" "null"))
        (assert (damaged-element-category query-yes))
        (assert (header 2))
)
(if (or (eq ?response yes)
        (eq ?response y)
    )
    then
    (assert (output-files repaired-yes))
    (bind ?wood 0)
    (bind ?wire 0)
    (bind ?plywood 0)
    (bind ?shotcrete 0)
    (bind ?water 0)
    (bind ?knees 0)
    (bind ?kit 0)
    (bind ?glulam 0)
    (bind ?time 0)
    (bind ?load 0)
    (if (eq ?repair "SHOTCRETE SEAL")
        then
        (assert (element-header ?element-number ?description
                        ?damage-mode "SHOTCRETE"))
        (bind ?shotcrete (* (/ (* (* (/ 6 12) ?width) ?length)27)1.5) )
        (bind ?water (* ?shotcrete 30) )
        (bind ?time (+ (/ ?shotcrete 1.8) 0.75) )
    )
    (if (eq ?repair "SHOTCRETE VERTICAL")
        then
        (assert (element-header ?element-number ?description
                        ?damage-mode "SHOTCRETE"))
        (bind ?area (* ?width ?height) )
        (bind ?wood (* ?area 0.417) )
        (bind ?wire ?area)
        (bind ?plywood (* (+ ?width 2) (+ ?height 2) ) )
        (bind ?shotcrete (* (/ (* (* (/ ?diml 12) ?height) ?width)
                          27) 1.5) )
        (bind ?water (* ?shotcrete 30) )
        (bind ?time (+ (/ ?shotcrete 1.8) 0.75) )
    )
    (if (eq ?repair "SHOTCRETE HORIZ")
        then
        (assert (element-header ?element-number ?description
                        ?damage-mode "SHOTCRETE"))
        (bind ?area (* ?width ?length) )
        (bind ?wood (+(* ?area 0.417) (* (* (/ ?length 4) (/ ?width 4) )
                    ?height) ) )
        (bind ?wire ?area)
        (bind ?plywood (* (+ ?width 2) (+ ?length 2) ) )
        (bind ?shotcrete (/(*(*(*(/ ?diml 12)?length)?width)1.5)27) )
        (bind ?water (* ?shotcrete 30) )
```

```
                (bind ?time (+ (+ (/ ?shotcrete 1.8) 0.75) 1) )
            )
            (if (eq ?repair "PLYWOOD COVER")
                then
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
                (if (or (eq ?description "EXTERIOR WALL")
                        (eq ?description "INTERIOR WALL")
                    )
                    then
                    (bind ?plywood (* (+ ?width 2) (+ ?height 2)) )
                    else
                    (bind ?plywood (* (+ ?width 2) (+ ?length 2)) )
            )
            (bind ?time .5)
            )
            (if (eq ?repair "SHORE FLOOR")
                then
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
                (bind ?time 1.0)
                (bind ?wood (* (* (/ ?length 4) (/ ?width 4) ) ?height) )
                (bind ?plywood (* (+ ?width 2) (+ ?length 2) ) )
            )
            (if (eq ?repair "UNDETERMINED")
                then
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
            )
            (if (eq ?repair "BEYOND REPAIR")
                then
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
            )
            (assert (output-files repaired-yes))
            (assert (output-data ?wood ?wire ?plywood ?shotcrete ?water ?knees
                                 ?kit ?glulam ?time ?width ?height ?length
                                 ?load ?remarks))
            (if (eq ?output output-on)
                then
                (assert (header 6))
            )
        )
        (if (not (or (eq ?response yes)
                     (eq ?response no)
                     (eq ?response y)
                     (eq ?response n) ) )
            then
            (fprintout t crlf " " ?response " IS NOT A VALID RESPONSE.")
            (fprintout t crlf "HIT < enter > TO CONTINUE.")
            (assert (dv1 =(readline)))
            (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
            (assert (repair-strategy-assignment on))
            (assert (header 5))
        )
)

;;;;;;;;

(defrule REPAIR-STRATEGIES-SECTION-2
        ?ready1 <- (repair-strategy-assignment on)
        ?ready2 <- (element-header ?element-number ?description
                        ?damage-mode ?repair)
        (building-header ?bldg-number ?bldg-priority ?bldg-description
```

```
                ?bldg-function)
        (data ?width ?height ?length)
        (setup ?help ?input ?output ?comm)
        (or (COLUMN ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3 ?variable)
            (BEAM ?element-number ?mat ?floor ?dim1 ?dim2 ?dim3 ?variable)
        )
=>
        (retract ?ready1)
        (if (eq ?input input-on)
            then
            (fprintout t crlf "IS THE INPUT INFORMATION GIVEN ABOVE CORRECT ?"
                       crlf "ENTER < yes > OR < no > : ")
            (bind ?response (read))
            else
            (bind ?response yes)
        )
        (if (or (eq ?response yes)
                (eq ?response y)
            )
            then
            (fprintout t crlf "ENTER ANY APPLICABLE REMARKS ABOUT THIS "
                       "ASSESSMENT" crlf "(or hit < enter > to continue): ")
            (bind ?remarks (readline))
        )
        (if (or (eq ?response no)
                (eq ?response n) )
                then
                (fprintout t crlf crlf "INPUT DATA IS INCORRECT."
                           crlf "HIT < enter > TO CONTINUE. ")
                (assert (dv1 =(readline)))
                (assert (building-header ?bldg-number ?bldg-priority
                                ?bldg-description ?bldg-function))
                (assert (element-header 0 "null" "null" "null"))
                (assert (damaged-element-category query-yes))
                (assert (header 2))
        )
        (if (or (eq ?response yes)
                (eq ?response y)
            )
            then
            (assert (output-files repaired-yes))
            (bind ?wood 0)
            (bind ?wire 0)
            (bind ?plywood 0)
            (bind ?shotcrete 0)
            (bind ?water 0)
            (bind ?knees 0)
            (bind ?kit 0)
            (bind ?glulam 0)
            (bind ?time 0)
            (bind ?load 0)
            (if (eq ?repair "SHOTCRETE COLUMN")
                then
                (retract ?ready2)
                (assert (element-header ?element-number ?description
                                ?damage-mode "SHOTCRETE"))
                (bind ?wood (/ (+ ?dim1 ?dim2) 3) )
                (bind ?plywood (* (* (/ (+ ?dim1 ?dim2) 12) (+ ?height 2) ) 2) )
                (bind ?shotcrete (* (/ (* (* (/ ?dim1 12) (/ ?dim2 12)) ?length)
                                27) 1.5) )
                (bind ?water (* ?shotcrete 30) )
                (bind ?time (+ (/ ?shotcrete 1.8) 0.75) )
            )
            (if (eq ?repair "COLUMN SPLINT")
                then
```

```
                (if (<= ?variable 100)
                    then
                    (bind ?kit 1)
                    else
                    (if (>= ?variable 200)
                        then
                        (bind ?kit 3)
                        else
                        (bind ?kit 2)
                    )
                )
                (bind ?time .5)
            )
            (if (eq ?repair "COLUMN SHORE")
                then
                (bind ?glulam ?height)
                (if (eq ?description "COLUMN")
                    then
                    (bind ?time 1.0)
                    else
                    (retract ?ready2)
                    (bind ?time 2.0)
                    (assert (element-header ?element-number ?description
                                ?damage-mode "REMOVE WALL, COLUMN SHORE"))
                )
            )
            (if (eq ?repair "KING-POST")
                then
                (bind ?wood 16.0)
                (bind ?wire (* (+ ?length 20) 1.5) )
                (bind ?time 1.0)
            )
            (if (eq ?repair "KNEE-BRACE")
                then
                (bind ?knees 2)
                (bind ?time 1.0)
            )
            (assert (output-files repaired-yes))
            (assert (output-data ?wood ?wire ?plywood ?shotcrete ?water ?knees
                                 ?kit ?glulam ?time ?width ?height ?length
                                 ?load ?remarks))
            (if (eq ?output output-on)
                then
                (assert (header 6))
            )
        )
        (if (not (or (eq ?response yes)
                     (eq ?response no)
                     (eq ?response y)
                     (eq ?response n) ) )
                then
                (fprintout t crlf " " ?response " IS NOT A VALID RESPONSE.")
                (fprintout t crlf "HIT < enter > TO CONTINUE.")
                (assert (dv1 =(readline)))
                (assert (element-header ?element-number ?description
                                ?damage-mode ?repair))
                (assert (repair-strategy-assignment on))
                (assert (header 5))
        )
)

;;;;;;;;                    OUTPUT TO DATA FILES                    ;;;;;;;;

(defrule OUTPUT-TO-FILES
```

```
        ?ready1 <- (output-files ?repaired)
        ?ready2 <- (assessment-number ?assessment)
        (building-header ?bldg-number ?bldg-priority ?bldg-description
                         ?bldg-function)
        (element-header ?element-number ?description ?damage-mode ?repair)
        (output-data ?wood ?wire ?plywood ?shotcrete ?water ?knees
                     ?kit ?glulam ?time ?width ?height ?length ?load ?remarks)
        (setup ?help ?input ?output ?comm)
        ?ready3 <- (carrage-return ?lines ?line-feed)
        ?ready4 <- (dcc-files ?status)
=>
        (retract ?ready1 ?ready3 ?ready4)
        (assert (dcc-files yes))
        (if (eq ?repaired repaired-no)
            then
            (fprintout t crlf crlf "BUILDING " ?bldg-number " HAS BEEN"
                       " DESIGNATED AS BEING BEYOND EXPEDIENT REPAIR."
                       crlf "NO MANPOWER OR EQUIPMENT WILL BE SCHEDULED."
                       crlf crlf "HIT < enter > TO CONTINUE: ")
            (assert (dv1 =(readline)))
            (fprintout ta1 "     Damage to building number " ?bldg-number
                           " places it beyond expedient repair." crlf
                           "     No manpower or equipment will be scheduled."
                           crlf crlf crlf)
            (assert (quit level-building 1))
        )
        (if (eq ?repaired repaired-yes)
            then
            (if (and (eq ?input input-on)
                     (eq ?output output-on)
                )
                then
                (fprintout t "POST-DAM HAS SELECTED THE ABOVE REPAIR STRATEGY."
                             crlf crlf "HIT < enter > TO CONTINUE. ")
                (assert (dv1 =(readline)))
            )
            (if (> ?assessment 1)
                then
                (bind ?line-feed (- ?lines ?line-feed))
                (while (> ?line-feed 0) do
                    (fprintout ta1 crlf)
                    (bind ?line-feed (- ?line-feed 1))
                )
                (format ta1 "%n%n%56s%n%45s%5d%n%52s%n%45s%n"
                            "POST-ATTACK DAMAGE ASSESSMENT OF"
                            "FACILITY NUMBER" ?bldg-number
                            "BITBURG AIR BASE, GERMANY"
                            "(continue)")
                (fprintout ta1 "                                                "
                               "                                                ")
                (fprintout ta1 crlf crlf crlf)
                (bind ?line-feed (+ ?line-feed 9))
            )
            (format ta1 "%33s%-40d%n"
                        "Damage Assessment Number :  " ?assessment)
            (format ta1 "%n%36s%n%n" "A.) General Element Information")
            (format ta1 "%32s%-40d%n%32s%-40s%n%32s%-40s%n"
                        "Element Number      :  " ?element-number
                        "Element Description :  " ?description
                        "Damage Mode         :  " ?damage-mode)
            (bind ?line-feed (+ ?line-feed 7))
            (if (> ?width 0)
                then
                (format ta1 "%32s%-4.1f%4s%n"
                        "Damage Width        :  " ?width " ft.")
```

```
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?height 0)
    then
    (format ta1 "%32s%-4.1f%4s%n"
            "Damage Height       :  " ?height " ft.")
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?length 0)
    then
    (format ta1 "%32s%-4.1f%4s%n"
            "Damage Length       :  " ?length " ft.")
    (bind ?line-feed (+ ?line-feed 1))
)
(format ta1 "%32s%-40s%n"
            "Repair Strategy     :  " ?repair)
(format ta1 "%n%36s%n%n" "B.) Repair Strategy Information")
(format ta1 "%33s%n%n" "1.) Required Materials :")
(bind ?line-feed (+ ?line-feed 6))
(if (> ?wood 0)
    then
    (bind ?wood-quantity (+ 1 (trunc (/ ?wood 16))))
    (format ta1 "%35s%5.1f%-20s%n"
            "Grade A 2x4         :  " ?wood " ft.")
    (format ta2 " \"%d\" \"2x4 16ft\" \"%d\" \"ea\" %n"
                ?assessment ?wood-quantity)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?plywood 0)
    then
    (bind ?plywood-quantity (+ 1 (trunc (/ ?plywood 32))))
    (format ta1 "%35s%5.1f%-20s%n"
            "Grade A Plywood     :  " ?plywood " sq. ft.")
    (format ta2 " \"%d\" \"plywood 4x8 .5in\" \"%d\" \"ea\" %n"
                ?assessment ?plywood-quantity)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?wire 0)
    then
    (format ta1 "%35s%5.1f%-20s%n"
            "Wire Mesh           :  " ?wire " sq. ft.")
    (format ta2 " \"%d\" \"wire mesh\" \"%6.1f\" \"sqf\" %n"
                ?assessment ?wire)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?shotcrete 0)
    then
    (format ta1 "%35s%5.1f%-20s%n"
            "Shotcrete Material :  " ?shotcrete " cubic yards")
    (format ta2 " \"%d\" \"shotcrete\" \"%6.1f\" \"cy\" %n"
                ?assessment ?shotcrete)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?water 0)
    then
    (format ta1 "%35s%5.1f%-20s%n"
            "Water               :  " ?water " gallons")
    (format ta2 " \"%d\" \"water\" \"%6.1f\" \"gal\" %n"
                ?assessment ?water)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?kit 0)
    then
    (format ta1 "%35s%d%n"
            "Column Splint Kit   :  " ?kit)
```

```
    (format ta2 " \"%d\" \"column splint\" \"%d\" \"ea\" %n"
                ?assessment ?kit)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?glulam 0)
    then
    (format ta1 "%35s%5.1f%-20s%n"
           "Glulam Column      :  " ?glulam " feet")
    (format ta2 " \"%d\" \"glulam column 12x12 10ft\" \"1\" \"ea\"
                %n" ?assessment)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (> ?knees 0)
    then
    (format ta1 "%35s%5.1f%-20s%n"
           "Knee Braces        :  " ?knees " each")
    (format ta2 " \"%d\" \"knee brace\" \"2\" \"ea\" %n"
                ?assessment)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (eq ?repair "KING-POST")
    then
    (format ta1 "%35s%-20s%n"
           "Turnbuckle         :  " "  1.0 each")
    (format ta2
        " \"%d\" \"turnbuckle\" \"1\" \"ea\" %n"
                ?assessment)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (eq ?time 0)
    then
    else
    (bind ?temp1 (trunc (+ ?time 0)))
    (bind ?temp2 (+ ?temp1 1))
    (bind ?temp2 (- ?temp2 ?time))
        (if (> ?temp2 0.75)
            then (bind ?time (+ ?temp1 0.25))
            else (if (> ?temp2 0.50)
                  then (bind ?time (+ ?temp1 0.50))
                  else (if (> ?temp2 0.25)
                        then (bind ?time (+ ?temp1 0.75))
                        else (if (> ?temp2 0.00)
                              then (bind ?time (+ ?temp1 1.00))
                              else (bind ?time (+ ?temp1 0))
)       )       )       )       )
(format ta1 "%n%33s%n%n" "2.) Required Equipment :")
(bind ?line-feed (+ ?line-feed 3))
(if (eq ?repair "SHOTCRETE")
    then
    (format ta1 "%46s%1s%n"
           "Shotcrete Unit w/ Accessories :  " "1" )
    (format ta3
        " \"%d\" \"sc machine\" \"1\" \"ea\" \"%6.2f\" %n"
                ?assessment ?time)
    (bind ?line-feed (+ ?line-feed 1))
)
(if (or (eq ?repair "SHOTCRETE")
        (eq ?repair "PLYWOOD COVER")
        (eq ?repair "SHORE FLOOR")
        (eq ?repair "COLUMN SHORE")
    )
    then
    (if (eq ?damage-mode "EXCESSIVE CRACKING")
        then
        else
```

```
                (format ta1 "%46s%1s%n"
                        "Ramset w/ Stud                 :  " "2" )
                (format ta3
                    " \"%d\" \"ramset\" \"2\" \"ea\" \"%6.2f\" %n"
                        ?assessment ?time)
                (bind ?line-feed (+ ?line-feed 1))
            )
        )
        (if (or (eq ?repair "SHORE FLOOR")
                (eq ?repair "COLUMN SHORE")
            )
            then
            (format ta1 "%46s%1s%n"
                    "Shoring Jack                   :  " "1" )
            (format ta3
                " \"%d\" \"shoring jack\" \"1\" \"ea\" \"%6.2f\" %n"
                        ?assessment ?time)
            (bind ?line-feed (+ ?line-feed 1))
            (if (eq ?repair "COLUMN SHORE")
                then
                (format ta1 "%46s%1s%n"
                        "Chain saw                      :  " "1" )
                (format ta3
                    " \"%d\" \"chainsaw\" \"1\" \"ea\" \"%6.2f\" %n"
                        ?assessment ?time)
                (bind ?line-feed (+ ?line-feed 1))
            )
        )
        (format ta1 "%n%38s%n%n" "3.) Estimated Manpower/Time :")
        (if (eq ?repair "BEYOND REPAIR")
            then
            else
            (format ta1 "%34s%1s%n"
                    "Repair Team(s)    :  " "1" )
            (format ta1 "%34s%5.2f%n"
                    "Repair Team Hours :  " ?time)
            (format ta3 " \"%d\" \"repair team\" \"1\" \"ea\" \"%6.2f\" %n"
                    ?assessment ?time)
        )
        (format ta1 "%n%23s%n%n" "4.) Remarks  :")
        (format ta1 "%13s%-60s%n" " " ?remarks)
        (format ta1 "%n%31s%n%n" "5.) Repair Schedule  :")
        (format ta1 "%13s%16s%n%13s%16s%n" " " "Start Repair  : "
                                           " " "Finish Repair : ")
        (bind ?line-feed (+ ?line-feed 15))
        (assert (carrage-return ?lines ?line-feed))
        (assert (damaged-element-category query-yes))
        (bind ?value (+ ?assessment 1))
        (retract ?ready2)
        (assert (assessment-number ?value))
        (assert (header 2))
    )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                          QUIT                                 ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule QUIT
        ?ready1 <- (quit ?level ?phase)
        (building-header ?bldg-number ?bldg-priority ?bldg-description
                         ?bldg-function)
        ?ready2 <- (?card-number facility-header ?bldg-number ?facility-priority
                    ?facility-function ?facility-description ?assessed)
        (setup ?help ?input ?output ?comm)
```

```
        (dcc-files ?status)
=>
        (retract ?ready1)
        (if (eq ?level level-shell)
            then
            (if (eq ?comm comm-on)
                then
                (if (eq ?status yes)
                    then
                    (system "erase c:\\postdam\\dcc\\files.dcc")
                    (system "cls")
                    (system "type c:\\postdam\\pd\\comm_2.pd")
                    (format t "%n%n%10s%34s"
                              " " "HIT < enter > TO TRANSMIT FILES : ")
                )
            )
            (exit)
            else
            (if (eq ?level level-building)
                then
                (retract ?ready2)
                (if (eq ?phase 1)
                    then
                    (format ta1 "%n%18s%38s%5d%18s"
                                "**************** "
                                "END OF OUTPUT DATA FOR BUILDING NUMBER"
                                ?bldg-number
                                " ****************")
                    (close ta1)
                    (close ta2)
                    (close ta3)
                )
                (bind ?repeat no)
                (if (eq ?comm comm-on)
                    then
                    (if (eq ?status yes)
                        then
                        (if (eq ?phase 1)
                            then
                            (system "del c:\\postdam\\dcc\\files.dcc")
                        )
                        (system "cls")
                        (system "type c:\\postdam\\pd\\comm_1.pd")
                        (format t "%n%n%10s%23s"
                                  " " "SELECT OPTION 1 TO 3 : ")
                        (bind ?response (read))
                        (if (eq ?response 1)
                            then
                            (system "del c:\\postdam\\dcc\\return.com")
                            (exit)
                            else
                            (if (eq ?response 2)
                                then
                                (exit)
                                else
                                (if (eq ?response 3)
                                    then
                                    (open "c:\\postdam\\dcc\\files.dcc" ca2 "w")
                                    (close ca2)
                                    else
                                    (format t "%10s%17s%29s"
                                              " " "INVALID RESPONSE."
                                              " HIT < enter > TO CONTINUE. ")
                                    (assert (dv1 =(readline)))
                                    (bind ?repeat yes)
```

```
                                    (assert (quit ?level 2))
                                    (assert (?card-number facility-header
                                       ?bldg-number ?facility-priority
                                       ?facility-function ?facility-description
                                       ?assessed))
                )   )   )   )   )
                (if (eq ?repeat yes)
                    then
                    else
                    (assert (?card-number facility-header ?bldg-number
                        ?facility-priority ?facility-function
                        ?facility-description YES))
                    (assert (reset-facts-list-and-reinitialize))
                )
                else
                (assert (damaged-element-category query-yes))
                (assert (header 2))
            )
        )
)


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                        RESET FACTS LIST                       ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule RESET-FACTS-LIST
        (and ?ready1 <- (reset-facts-list-and-reinitialize)
             (or ?ready2 <- (building-header ?bldg-number ?bldg-priority
                                ?bldg-description ?bldg-function)
                 ?ready2 <- (MISSION-CRITICAL-EXTERIOR-WALLS $?)
                 ?ready2 <- (MISSION-CRITICAL-INTERIOR-WALLS $?)
                 ?ready2 <- (MISSION-CRITICAL-ROOFS $?)
                 ?ready2 <- (MISSION-CRITICAL-FLOORS $?)
                 ?ready2 <- (MISSION-CRITICAL-BEAMS $?)
                 ?ready2 <- (MISSION-CRITICAL-COLUMNS $?)
                 ?ready2 <- (MISSION-CRITICAL-DOORS $?)
                 ?ready2 <- (MISSION-CRITICAL-MISCELLANEOUS $?)
                 ?ready2 <- (EXTERIOR-WALL $?)
                 ?ready2 <- (INTERIOR-WALL $?)
                 ?ready2 <- (ROOF $?)
                 ?ready2 <- (FLOOR $?)
                 ?ready2 <- (BEAM $?)
                 ?ready2 <- (COLUMN $?)
                 ?ready2 <- (DOOR $?)
                 ?ready2 <- (MISCELLANEOUS $?)
                 ?ready2 <- (assessment-number ?)
                 ?ready2 <- (building-header $?)
                 ?ready2 <- (element-header $?)
                 ?ready2 <- (data $?)
                 ?ready2 <- (output-data $?)
                 ?ready2 <- (carrage-return ?lines ?line-feed)
             )
        )
=>
        (retract ?ready2)
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                        REINITIALIZE                           ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule REINITIALIZE
        ?ready1 <- (reset-facts-list-and-reinitialize)
        (setup ?help ?input ?output ?comm)
```

```
        (not (building-header ?bldg-number ?bldg-priority
                        ?bldg-description ?bldg-function) )
        (not (MISSION-CRITICAL-EXTERIOR-WALLS $?) )
        (not (MISSION-CRITICAL-INTERIOR-WALLS $?) )
        (not (MISSION-CRITICAL-ROOFS $?) )
        (not (MISSION-CRITICAL-FLOORS $?) )
        (not (MISSION-CRITICAL-BEAMS $?) )
        (not (MISSION-CRITICAL-COLUMNS $?) )
        (not (MISSION-CRITICAL-DOORS $?) )
        (not (MISSION-CRITICAL-MISCELLANEOUS $?) )
        (not (EXTERIOR-WALL $?) )
        (not (INTERIOR-WALL $?) )
        (not (ROOF $?) )
        (not (FLOOR $?) )
        (not (BEAM $?) )
        (not (COLUMN $?) )
        (not (DOOR $?) )
        (not (MISCELLANEOUS $?) )
        (not (assessment-number ?) )
        (not (building-header $?) )
        (not (element-header $?) )
        (not (data $?) )
        (not (output-data $?) )
        (not (carrage-return ?lines ?line-feed) )
=>
        (retract ?ready1)
        (assert (building-header 0 0 "null" "null"))
        (assert (element-header 0 "null" "null" "null"))
        (assert (assessment-number 1))
        (assert (data 0 0 0))
        (assert (carrage-return 67 0))
        (assert (trigger damaged-bldg-id 1))
        (assert (header 1))
)


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                          HEADERS                          ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule HEADER
        ?ready <- (header ?level)
        (building-header ?bldg-number ?bldg-priority ?bldg-description
                         ?bldg-function)
        (assessment-number ?assessment)
        (element-header ?element-number ?description ?damage-mode ?repair)
        (data ?width ?height ?length)
        (setup ?help ?input ?output ?comm)
=>
        (retract ?ready)
        (system "cls")
        (if (eq ?input input-on)
            then
            (fprintout t      "       ********************************"
                              "********************************")
            (format t "%n%8s%34s%27s" "*" "POST-DAM" "*")
            (if (>= ?level 2)
                then
                (fprintout t crlf "       ********************************"
                                  "********************************")
                (format t "%n%8s%61s%n%8s%13s%48s"
                          "*" "*" "*" "INPUT DATA:" "*")
                (format t "%n%8s%5s%-27s%2s%-26d%1s"
                          "*" " " "BUILDING NUMBER" ": " ?bldg-number "*")
                (if (= ?level 2.5)
```

```
                    then
                    (format t "%n%8s%5s%-27s%2s%-26s%1s"
                          "*" " " "ELEMENT DESCRIPTION" ": " ?description "*")
                )
                (if (>= ?level 3)
                    then
                    (format t "%n%8s%5s%-27s%2s%-26d%1s%n%8s%5s%-27s%2s%-26s%1s"
                          "*" " " "ELEMENT NUMBER" ": " ?element-number "*"
                          "*" " " "ELEMENT DESCRIPTION" ": " ?description "*")
                    (if (>= ?level 4)
                        then
                        (format t "%n%8s%5s%-27s%2s%-26s%1s"
                              "*" " " "DAMAGE MODE" ": " ?damage-mode "*")
                        (if (>= ?level 5)
                            then
                            (if (> ?width 0)
                                then
                                (format t "%n%8s%5s%-27s%2s%-26.1f%1s"
                                          "*" " " "WIDTH" ": " ?width "*")
                            )
                            (if (> ?height 0)
                                then
                                (format t "%n%8s%5s%-27s%2s%-26.1f%1s"
                                          "*" " " "HEIGHT" ": " ?height "*")
                            )
                            (if (> ?length 0)
                                then
                                (format t "%n%8s%5s%-27s%2s%-26.1f%1s"
                                          "*" " " "LENGTH" ": " ?length "*")
                            )
                        )
                    )
                )
            (format t "%n%8s%61s%n%8s%2s%-58s%1s"
                      "*" "*" "*" " " "GENERAL INFORMATION:" "*")
            (format t "%n%8s%5s%-27s%2s%-26s%1s%n%8s%5s%-27s%2s%-26s%1s"
                      "*" " " "BUILDING DESCRIPTION" ": " ?bldg-description "*"
                      "*" " " "BUILDING FUNCTION" ": " ?bldg-function "*").
                (if (>= ?level 2)
                    then
                    (format t "%n%8s%5s%-27s%2s%-26d%1s"
                      "*" " " "DAMAGE ASSESSMENT NUMBER" ": " ?assessment "*")
                )
            )
            (if (>= ?level 6)
                then
                (format t "%n%8s%61s%n%8s%2s%-58s%1s"
                          "*" "*" "*" " " "OUTPUT DATA:" "*")
                (format t "%n%8s%5s%-27s%2s%-26s%1s"
                          "*" " " "REPAIR STRATEGY" ": " ?repair "*")
            )
            (fprintout t crlf "       ********************************"
                              "********************************")
                (fprintout t crlf)
        else
    )
)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                          SETUP                                ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule SETUP
        ?ready1 <- (setup modify ?temp)
        ?ready2 <- (setup ?help ?input ?output ?comm)
=>
```

```
(retract ?ready1 ?ready2)
(if (eq ?help help-on)
    then
    (bind ?uhelp ON)
    else
    (bind ?uhelp OFF)
)
(if (eq ?input input-on)
    then
    (bind ?uinput ON)
    else
    (bind ?uinput OFF)
)
(if (eq ?output output-on)
    then
    (bind ?uoutput ON)
    else
    (bind ?uoutput OFF)
)
(if (eq ?comm comm-on)
    then
    (bind ?ucomm ON)
    else
    (bind ?ucomm OFF)
)
(system "cls")
(if (eq ?temp 1)
    then
    (system "type c:\\postdam\\pd\\setup_1.pd")
    (format t "%n%n%53s" "HIT < enter > TO CONTINUE : ")
    (assert (dv1 =(readline)))
    (assert (setup ?help ?input ?output ?comm))
    (assert (setup modify 2))
    else
    (system "type c:\\postdam\\pd\\setup_2.pd")
    (format t
        "%62s%n%n"
        "POST-DAM UTILITIES ARE CONFIGURED AS FOLLOWS : ")
    (format t
        "%53s%-10s%n%53s%-10s%n%53s%-10s%n%53s%-10s%n%53s"
        "(1.) HELP OPTION              : " ?uhelp
        "(2.) INPUT TO SCREEN OPTION   : " ?uinput
        "(3.) OUTPUT TO SCREEN OPTION  : " ?uoutput
        "(4.) FILE TRANSFER TO DCC     : " ?ucomm
        "(5.) QUIT MODIFICATIONS         ")
    (format t "%n%n%56s" "MODIFY OPTION 1 TO 4 (OR 5 TO QUIT) : ")
    (bind ?response (read))
    (if (eq ?response 5)
        then
        (assert (setup ?help ?input ?output ?comm))
        (assert (trigger damaged-bldg-id 1))
        (assert (header 1))
        else
        (if (eq ?response 1)
            then
            (if (eq ?uhelp ON)
                then
                (bind ?help help-off)
                else
                (bind ?help help-on)
            )
        )
        (if (eq ?response 2)
            then
            (if (eq ?uinput ON)
```

```
                    then
                    (bind ?input input-off)
                    else
                    (bind ?input input-on)
                )
            )
            (if (eq ?response 3)
                then
                (if (eq ?uoutput ON)
                    then
                    (bind ?output output-off)
                    else
                    (bind ?output output-on)
                )
            )
            (if (eq ?response 4)
                then
                (if (eq ?ucomm ON)
                    then
                    (bind ?comm comm-off)
                    else
                    (bind ?comm comm-on)
                )
            )
            (assert (setup ?help ?input ?output ?comm))
            (assert (setup modify 2))
        )
    )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;                          HELP                                ;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defrule HELP_1
    ?ready1 <- (utility help-1 ?number-of-facility-cards ?card-number)
    (?card-number facility-header ?facility-number ?facility-priority
                  ?facility-function ?facility-description ?assessed)
=>
    (retract ?ready1)
    (if (eq ?card-number 1)
        then
        (system "cls")
        (system "type c:\\postdam\\pd\\help_1.pd")
    )
    (format t "%n%8d%11d%20s%25s%10s"
            ?facility-number ?facility-priority ?facility-function
            ?facility-description ?assessed)
    (if (eq ?card-number ?number-of-facility-cards)
        then
        (format t "%n%n%n%50s"
                  "SELECT FACILITY NUMBER TO BE ASSESSED : ")
        (assert (trigger damaged-bldg-id 2))
        else
        (bind ?card-number (+ ?card-number 1))
        (assert (utility help-1 ?number-of-facility-cards ?card-number))
    )
)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;  THE END OF PDES  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
```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APPENDIX B

PD.BAT SOURCE CODE

```
echo off
goto lable100
rem COMMENTS

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;                                                                             ;;;
;;;  PROGRAM TITLE       :  PD.BAT                                              ;;;
;;;  PROGRAM PURPOSE     :  DOS BATCH JOB RESPONSIBLE FOR COMPILATION AND       ;;;
;;;                         EXECUTION OF POST-DAM EXPERT SYSTEM (PDES).  ALSO   ;;;
;;;                         RESPONSIBLE FOR PDES OUTPUT FILE MANAGEMENT AND     ;;;
;;;                         EXECUTION OF CROSSTALK MK.4 COMMUNICATION           ;;;
;;;                         SYSTEM DCC.XTS.                                     ;;;
;;;  PROGRAM VERSION     :  1.02 (910215)                                       ;;;
;;;  DEVELOPED BY        :  APPLIED RESEARCH ASSOCIATES, INC.                   ;;;
;;;                         GULF COAST DIVISION.                                ;;;
;;;                                                                             ;;;
;;;  MODIFICATION RECORD  :                                                     ;;;
;;;                                                                             ;;;
;;;  VERSION     DATE RELEASE    PROGRAMMER              MODIFICATIONS          ;;;
;;;                                                                             ;;;
;;;   1.01         12/11/90      JEFF HOWARD    * ORIGINAL VERSION              ;;;
;;;   1.02         02/15/91      JEFF HOWARD    * HEADER CHANGES                ;;;
;;;                                             * FILE TRANSFER CAPABILITY ADDED ;;;
;;;                                             * CHANGES IN PDES SUB-DIRECTORIES ;;;
;;;                                                                             ;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

:lable100
if exist c:\postdam\*.out goto lable99
goto lable89
:lable99
del c:\postdam\*.out
cls
:lable89
if exist c:\postdam\*.mat goto lable98
goto lable88
:lable98
del c:\postdam\*.mat
cls
:lable88
if exist c:\postdam\*.eqp goto lable97
goto lable87
:lable97
del c:\postdam\*.eqp
cls
:lable87
if exist c:\postdam\dcc\*.out goto lable96
goto lable86
:lable96
del c:\postdam\dcc\*.out
cls
:lable86
if exist c:\postdam\dcc\*.mat goto lable95
goto lable85
:lable95
del c:\postdam\dcc\*.mat
cls
:lable85
if exist c:\postdam\dcc\*.eqp goto lable94
goto lable84
:lable94
del c:\postdam\dcc\*.mat
cls
:lable84
:lable1
```

```
cls
type c:\postdam\pd\pdes_on.pd
clips -f c:\postdam\bat\pd.run
cls
if exist c:\postdam\*.out goto lable79
goto lable69
:lable79
copy c:\postdam\*.out c:\postdam\dcc\*.*
copy c:\postdam\*.out c:\postdam\pd_files\*.*
del c:\postdam\*.out
cls
:lable69
if exist c:\postdam\*.mat goto lable78
goto lable68
:lable78
copy c:\postdam\*.mat c:\postdam\dcc\*.*
copy c:\postdam\*.mat c:\postdam\pd_files\*.*
del c:\postdam\*.mat
cls
:lable68
if exist c:\postdam\*.eqp goto lable77
goto lable67
:lable77
copy c:\postdam\*.eqp c:\postdam\dcc\*.*
copy c:\postdam\*.eqp c:\postdam\pd_files\*.*
del c:\postdam\*.eqp
cls
:lable67
cls
if not exist c:\postdam\dcc\files.dcc goto :lable2
goto :lable3
:lable2
c:\xtalk4\xtalk call dcc
if exist c:\postdam\dcc\*.out goto lable59
goto lable49
:lable59
del c:\postdam\dcc\*.out
cls
:lable49
if exist c:\postdam\dcc\*.mat goto lable58
goto lable48
:lable58
del c:\postdam\dcc\*.mat
cls
:lable48
if exist c:\postdam\dcc\*.eqp goto lable57
goto lable47
:lable57
del c:\postdam\dcc\*.eqp
cls
:lable47
if not exist c:\postdam\dcc\return.com goto :lable1
:lable3
cls
type c:\postdam\pd\logoff.pd
```


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APPENDIX C

PD_SYS.BAT SOURCE CODE

```
echo off
goto lable100
rem COMMENTS

:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
:::                                                                         :::
:::  PROGRAM TITLE        :  PD_SYS.BAT                                     :::
:::  PROGRAM PURPOSE      :  DOS BATCH JOB RESPONSIBLE FOR SETTING-UP THE   :::
:::                          CONFIG.SYS AND AUTOEXEC.BAT FILES FOR REMOTE   :::
:::                          COMPUTERS NOT SOLELY DEDICATED TO THE OPERATION :::
:::                          OF THE POST-DAM EXPERT SYSTEM (PDES).          :::
:::                                       ** WARNING! **                    :::
:::                          USE OF THIS BATCH JOB WILL ELIMINATE ANY DEVICES :::
:::                          DEFINED IN YOUR ORIGINAL CONFIG.SYS.  TO ADD   :::
:::                          NEEDED DEVICES, MODIFY CONFIG.PD.              :::
:::  PROGRAM VERSION      :  1.02 (910215)                                  :::
:::  DEVELOPED BY         :  APPLIED RESEARCH ASSOCIATES, INC.              :::
:::                          GULF COAST DIVISION                            :::
:::                                                                         :::
:::  MODIFICATION RECORD  :                                                 :::
:::                                                                         :::
:::  VERSION     DATE RELEASED   PROGRAMMER            MODIFICATION         :::
:::                                                                         :::
:::   1.01         12/11/90      JEFF HOWARD   * ORIGINAL VERSION           :::
:::   1.02         02/15/91      JEFF HOWARD   * HEADER ADDED               :::
:::                                            * SUB-DIRECTORY CHANGES      :::
:::                                            * AUTOEXEC.BAT ADDED         :::
:::                                                                         :::
:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

:lable100
cls
c:
cd\
copy c:\config.sys c:\pd_systm\config.tmp
copy c:\autoexec.bat c:\pd_systm\autoexec.tmp
copy c:\pd_systm\config.pd c:\config.sys
copy c:\pd_systm\autoexec.bat c:\autoexec.bat
cls
type c:\pd\pd_sys.mem
```

APPENDIX D

PD_NOSYS.BAT SOURCE CODE

```
echo off
goto lable100
rem COMMENTS

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;                                                                        ;;;
;;;  PROGRAM TITLE        :  PD_NOSYS.BAT                                  ;;;
;;;  PROGRAM PURPOSE      :  DOS BATCH JOB RESPONSIBLE FOR RETURNING THE   ;;;
;;;                          REMOTE COMPUTER TO ITS ORIGINAL (NON-PDES)    ;;;
;;;                          CONFIGURATION.                                ;;;
;;;  PROGRAM VERSION      :  1.02 (910215)                                 ;;;
;;;  DEVELOPED BY         :  APPLIED RESEARCH ASSOCIATES, INC.             ;;;
;;;                          GULF COAST DIVISION                           ;;;
;;;                                                                        ;;;
;;;  MODIFICATION RECORD  :                                                ;;;
;;;                                                                        ;;;
;;;  VERSION     DATE RELEASED   PROGRAMMER            MODIFICATIONS       ;;;
;;;                                                                        ;;;
;;;   1.01         12/11/90      JEFF HOWARD     * ORIGINAL VERSION        ;;;
;;;   1.02         02/15/91      JEFF HOWARD     * HEADER ADDED            ;;;
;;;                                              * SUB-DIRECTORY CHANGES   ;;;
;;;                                              * AUTOEXEC.BAT ADDED      ;;;
;;;                                                                        ;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

:lable100
cls
c:
cd\
copy c:\pd_systm\autoexec.tmp c:\autoexec.bat
copy c:\pd_systm\config.tmp c:\config.sys
del c:\pd_systm\autoexec.tmp
del c:\pd_systm\config.tmp
cls
type c:\pd\pd_sysno.mem
```

APPENDIX E

PD_NSTAL.BAT FILE

```
echo off
cls
goto lable100
rem COMMENTS

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
:::                                                                          :::
:::  PROGRAM TITLE       :  PD_NSTAL.BAT                                     :::
:::  PROGRAM PURPOSE     :  DOS BATCH JOB RESPONSIBLE FOR CREATING THE       :::
:::                         SUB-DIRECTORIES REQUIRED FOR THE POST-DAM        :::
:::                         EXPERT SYSTEM (PDES).  ALSO RESPONSIBLE FOR      :::
:::                         TRANSFERRING THE PDES FILES FROM THE SYSTEM      :::
:::                         DISKETTE TO THE REMOTE COMPUTER'S HARD DISK.     :::
:::  PROGRAM VERSION     :  1.02 (910215)                                    :::
:::  DEVELOPED BY        :  APPLIED RESEARCH ASSOCIATES, INC.                :::
:::                         GULF COAST DIVISION                              :::
:::                                                                          :::
:::  MODIFICATION RECORD  :                                                  :::
:::                                                                          :::
:::  VERSION    DATE RELEASED    PROGRAMMER              MODIFICATIONS       :::
:::                                                                          :::
:::   1.01        12/11/90       JEFF HOWARD    * ORIGINAL VERSION           :::
:::   1.02        02/15/91       JEFF HOWARD    * HEADER ADDED               :::
:::                                             * SUB-DIRECTORY CHANGES      :::
:::                                                                          :::
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

:lable100
cls
c:
cd\
type a:\nstal_1.fig
md c:\postdam
copy a:\postdam\*.* c:\postdam\*.*
cls
type a:\nstal_2.fig
PAUSE
cls
type a:\nstal_3.fig
md c:\pd_systm
copy a:\pd_systm\*.* c:\pd_systm\*.*
cls
type a:\nstal_4.fig
md c:\postdam\bat
copy a:\postdam\bat\*.* c:\postdam\bat\*.*
cls
type a:\nstal_4.fig
md c:\postdam\dat
copy a:\postdam\dat\*.* c:\postdam\dat\*.*
cls
type a:\nstal_4.fig
md c:\postdam\pd
copy a:\postdam\pd\*.* c:\postdam\pd\*.*
md c:\postdam\dcc
md c:\postdam\pd_files
cls
type a:\nstal_5.fig
cd postdam
```

APPENDIX F

CONFIG.PD FILE

```
device=rcd.sys
files=20
buffers=20
```

APPENDIX G

AUTOEXEC.PD FILE

```
@ECHO OFF
KEYB US
PROMPT  $e[40m $e[1;37;41m $p $e[1;33;44m $g
PATH=c:\;c:\postdam;c:\postdam\bat;c:\pd_systm;
MODE COM2:9600,N,8,1
cls
```

APPENDIX H

PDES TRUTH TABLES: CORRELATION BETWEEN POTENTIAL DAMAGE MODES AND EXPEDIENT REPAIR STRATEGIES

POTENTIAL DAMAGE MODES					ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES						PDES POSSESSES	
EXCESSIVE CRACKING	SMALL HOLE	WALL BREACH	OTHER	BEYOND REPAIR		SHOTCRETE SEAL	PLYWOOD COVER	SHOTCRETE	EARTH BERM	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	N/A	T	F	F	F	F	F	X	
F	T	F	F	F	N/A	F	T	F	F	F	F	X	
F	F	T	F	F	DAMAGED WALL ABOVE FIRST FLOOR.	F	F	T	F	F	F	X	
F	F	T	F	F	DAMAGED WALL IN BASEMENT OR FIRST FLOOR. BACK-FILL AVAILABLE.	F	F	F	T	F	F		X
F	F	F	T	F	N/A	F	F	F	F	T	F	X	
F	F	F	F	T	N/A	F	F	F	F	F	T	X	

TABLE H1

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : EXTERIOR WALL

POTENTIAL DAMAGE MODES					ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES					PDES POSSESSES	
EXCESSIVE CRACKING	SMALL HOLE	WALL BREACH	OTHER	BEYOND REPAIR		SHOTCRETE SEAL	PLYWOOD COVER	SHOTCRETE	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	N/A	T	F	F	F	F	X	
F	T	F	F	F	N/A	F	T	F	F	F	X	
F	F	T	F	F	N/A	F	F	T	F	F	X	
F	F	F	T	F	N/A	F	F	F	T	F	X	
F	F	F	F	T	N/A	F	F	F	F	T	X	

TABLE H2

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : INTERIOR WALL

POTENTIAL DAMAGE MODES					ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES					PDES POSSESSES	
EXCESSIVE CRACKING	SMALL HOLE	ROOF BREACH	OTHER	BEYOND REPAIR		SHOTCRETE SEAL	PLYWOOD COVER	SHOTCRETE	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	N/A	T	F	F	F	F	X	
F	T	F	F	F	N/A	F	T	F	F	F	X	
F	F	T	F	F	N/A	F	F	T	F	F	X	
F	F	F	T	F	N/A	F	F	F	T	F	X	
F	F	F	F	T	N/A	F	F	F	F	T	X	

TABLE H3

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : ROOF

POTENTIAL DAMAGE MODES					ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES					PDES POSSESSES	
EXCESSIVE CRACKING	SMALL HOLE	LARGE HOLE	OTHER	BEYOND REPAIR		SHOTCRETE SEAL	PLYWOOD COVER	SHOTCRETE	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	N/A	T	F	F	F	F	X	
F	T	F	F	F	N/A	F	T	F	F	F	X	
F	F	T	F	F	N/A	F	F	T	F	F	X	
F	F	F	T	F	N/A	F	F	F	T	F	X	
F	F	F	F	T	N/A	F	F	F	F	T	X	

TABLE H4

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : FLOOR

POTENTIAL DAMAGE MODES					ADDITIONAL INFORMATION (BEAM CONNECTION DESCRIPTION)	EXPEDIENT REPAIR STRATEGIES						PDES POSSESSES	
EXCESSIVE DEFORMATION	BEAM FAILURE	CONNECTION FAILURE	OTHER	BEYOND REPAIR		REMOVE WALL, COLUMN SHORE	KNEE-BRACE	KING POST	COLUMN SHORE	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	COLUMNS BOTH ENDS, SIDES ACCESSIBLE	F	F	T	F	F	F	X	
T	F	F	F	F	COLUMNS BOTH ENDS, SIDES NOT ACCESSIBLE	F	T	F	F	F	F	X	
T	F	F	F	F	COLUMN TO LOAD CARRYING WALL	F	T	F	F	F	F	X	
T	F	F	F	F	LOAD CARRYING WALLS BOTH ENDS	F	T	F	F	F	F	X	
T	F	F	F	F	LOAD CARRYING TO NON-LOAD CARRYING WALL	T	F	F	F	F	F	X	
T	F	F	F	F	NON-LOAD CARRYING WALLS BOTH ENDS	T	F	F	F	F	F	X	
T	F	F	F	F	COLUMN TO NON-LOAD CARRY WALLS	T	F	F	F	F	F	X	
T	F	F	F	F	OTHER	F	F	F	F	T	F	X	
F	T	F	F	F	N/A	F	F	F	T	F	F	X	
F	F	T	F	F	N/A	F	T	F	F	F	F	X	
F	F	F	T	F	N/A	F	F	F	F	T	F	X	
F	F	F	F	T	N/A	F	F	F	F	F	T	X	

TABLE H5

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : BEAM

POTENTIAL DAMAGE MODES						ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES						PDES POSSESSES	
SPALLING	CRACKING/STEEL DEBONDING	MAJOR DAMAGE/MISSING	CONNECTION FAILURE	OTHER	BEYOND REPAIR		SHOTCRETE COLUMN	COLUMN SPLINT	COLUMN SHORE	KNEE-BRACE	UNDETERMINED	BEYOND REPAIR	YES	NO
T	F	F	F	F	F	N/A	T	F	F	F	F	F	X	
F	T	F	F	F	F	N/A	F	T	F	F	F	F	X	
F	F	T	F	F	F	N/A	F	F	T	F	F	F	X	
F	F	F	T	F	F	N/A	F	F	F	T	F	F	X	
F	F	F	F	T	F	N/A	F	F	F	F	T	F	X	
F	F	F	F	F	T	N/A	F	F	F	F	F	T	X	

TABLE H6

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : COLUMN

POTENTIAL DAMAGE MODES			ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES				PDES POSSESSES	
DAMAGED OVERPRESSURE DOOR	DAMAGED AIRCRAFT SHELTER BLAST DOOR	DAMAGED PERSONNEL BLAST DOOR		SHOTCRETE SEAL	THIRD DOOR INSERTION	DOOR REPLACEMENT	PRYING FORCE	YES	NO
T	F	F	DOOR AREA DESTROYED.	T	F	F	F		X
T	F	F	ONE OF TWO DOORS DESTROYED.	F	T	F	F		X
T	F	F	ONE DOOR DAMAGED, DOOR FRAME INTACT.	F	F	T	F		X
F	T	F	N/A	F	F	F	T		X
F	F	T	N/A	T	F	F	F		X

TABLE H7

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : DOOR

POTENTIAL DAMAGE MODES	ADDITIONAL INFORMATION	EXPEDIENT REPAIR STRATEGIES	PDES POSSESSES	
MISCELLANEOUS		MISCELLANEOUS	YES	NO
T	ENTER COMMENTS ON DAMAGED ELEMENT	T		X

TABLE H8

TRUTH TABLE
CORRELATION BETWEEN PDES POTENTIAL DAMAGE MODES
AND EXPEDIENT REPAIR STRATEGIES

ELEMENT CATEGORY : MISCELLANEOUS

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